October 15, 1956 50 Cents

AVIATION WEEK

A McGRAW-HILL PUBLICATION

Army Displays Missile Arsenal

•

Navy Streamlines Aviation Supply

American's Boeing 707 and United's Douglas DC-8. Scheduled to start service in 1959, these turbojet airliners, with speeds close to 600 miles per hour, will cut coast-to-coast travel time to less than five hours.

aircraft of the future call for...

KAYLOCK

TRADE MARK

ALL METAL SELF-LOCKING NUTS

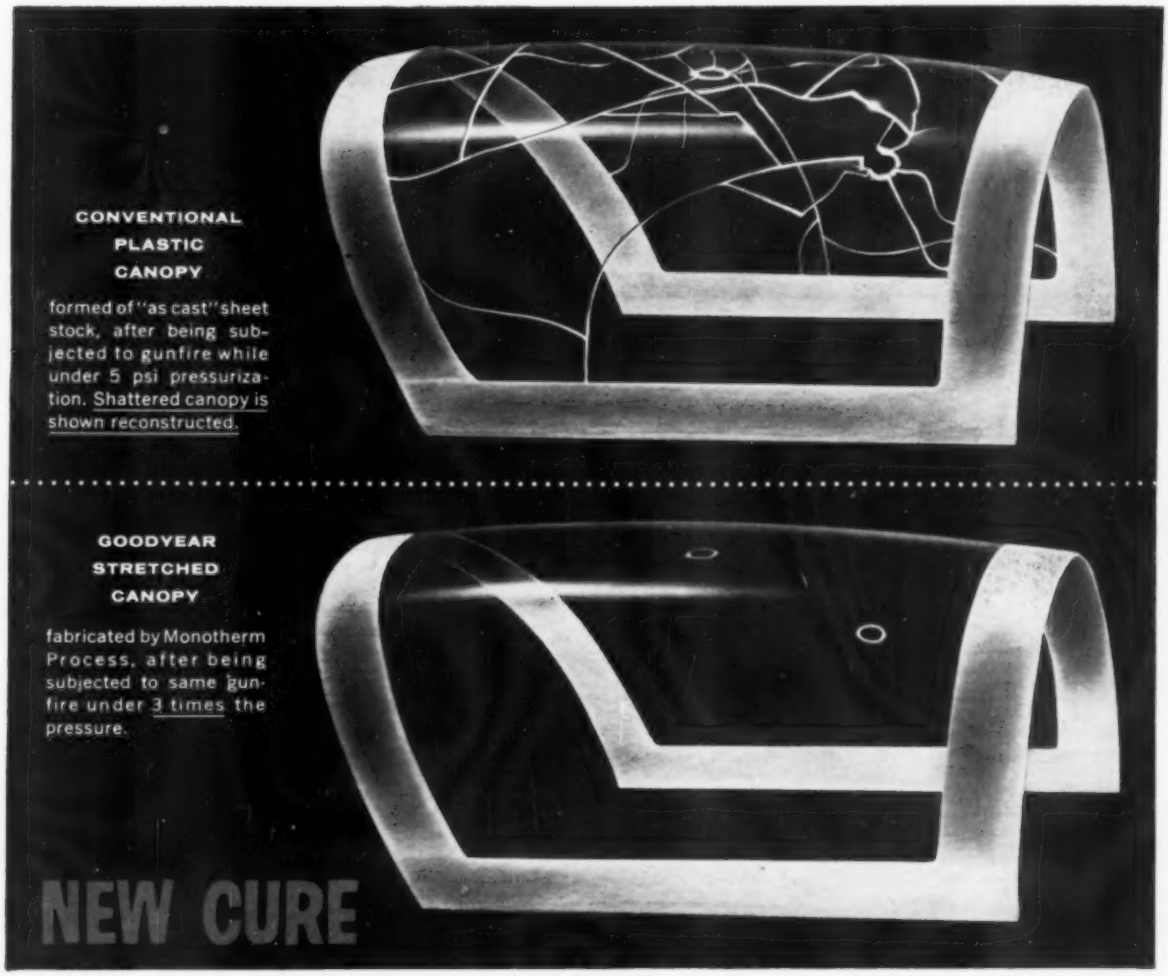
Great names in aviation keep *looking ahead* for improvement in aircraft design. That's why Douglas and Boeing have specified Kaylock self-locking nuts for the new Douglas DC-8 and Boeing 707 turbojet airliners.

Kaylock engineers, anticipating future needs in the field of aviation, have developed lighter-weight, higher-strength self-locking nuts to meet critical fastening needs of high-speed aircraft. The Kaylock name is a symbol of aircraft-fastener leadership, based not only on past performance, but on advanced development that provides tomorrow's parts today.

Kaylock Nuts are precision products produced in full conformance with Air Force-Navy specifications AN-N-5 and AN-N-10.

THE KAYNAR COMPANY • KAYLOCK DIVISION • BOX 2001, TERMINAL ANNEX • LOS ANGELES 54, CALIF. ©1956

Canadian Distributor: Abercorn Aero Limited, Montreal


CONVENTIONAL PLASTIC CANOPY
formed of "as cast" sheet stock, after being subjected to gunfire while under 5 psi pressurization. Shattered canopy is shown reconstructed.
GOODYEAR STRETCHED CANOPY
fabricated by Monotherm Process, after being subjected to same gunfire under 3 times the pressure.
NEW CURE

FOR OLD HEADACHES in a jet's headgear

Some time ago, the National Bureau of Standards uncovered a curious fact concerning the nature of acrylic plastic: stretch it under heat and its needle-like molecules tend to lie down and flatten out, making the material much tougher.

To Goodyear Aircraft, this phenomenon seemed to be the clue to solving the long-standing problems of shattering—and crazing due to stresses and solvents—in aircraft cockpit canopies.

But there was a hitch. Plastic has a "memory." Heat it once to stretch it—but heat it again to form it into the desired shape, and its molecules tend to fight their way back to their weaker original arrangement.

Goodyear Aircraft solved it by developing an exclusive MONOTHERM Process which achieves maximum stretch *and simultaneously forms the plastic in a single operation.*

Already, the weight-savings and toughness resulting from this technique have moved defense agencies and leading plane producers to place contracts with Goodyear Aircraft specifying stretched canopies formed by the MONOTHERM Process.

It is another example of Goodyear Aircraft pioneering in plastics. The organization which first stretch-formed a full-size canopy has once again set the pace for future progress in an important field. For information on these plastics facilities and skills, write:

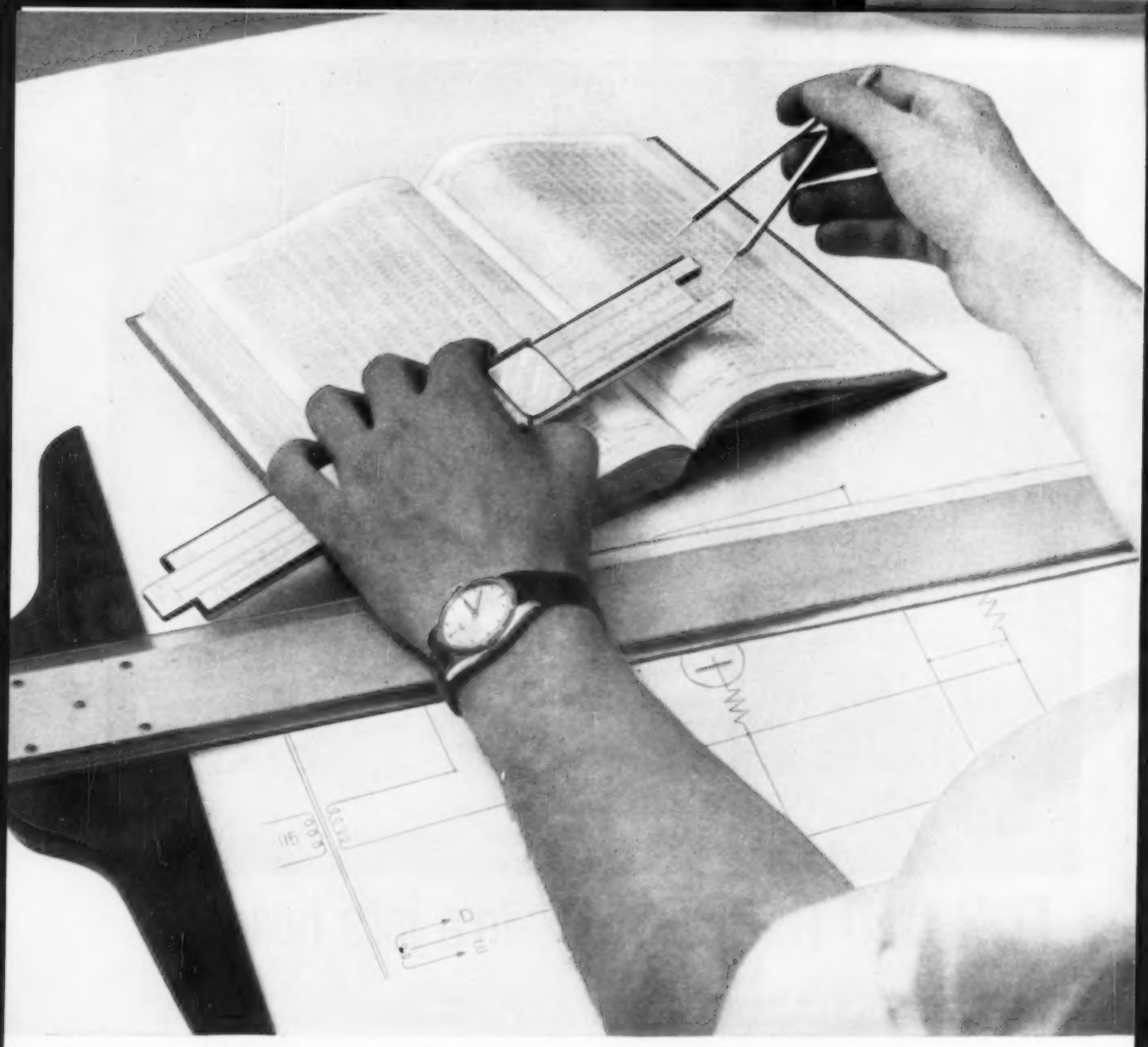
Goodyear Aircraft Corporation
Dept. 931AV, Akron 15, Ohio

S-T-R-E-T-C-H-E-D PLASTICS by

GOODYEAR AIRCRAFT

Plants in Akron, Ohio, and Litchfield Park, Arizona

Monotherm—T.M. Goodyear Aircraft Corporation, Akron 15, Ohio



What's most important in this picture?

Not the slide rule, though it's helpful. Nor the divider. Nor the logarithm table. It's the human hand, of course, because it is motivated by the long, strong arm of human intelligence. It belongs to the career engineer dedicated in his service to the Department of Defense.

His mind and his hand shorten the coupling between a need urgently expressed by the military and its translation by industry into reliable electronic equipment. His experience contributes invaluable help at a critical stage in developing great new things in aviation electronics.

LMEED

In Aviation Electronics Products Include . . .

FIRE CONTROL RADAR • SEARCH RADAR • INDICATORS AND DISPLAY • COUNTERMEASURES • NAVIGATION
MISSILE CONTROL • AIRBORNE SONAR • COMMUNICATIONS • FUZES • AUTOMATIC TEST • DATA PROCESSING

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Progress Is Our Most Important Product

GENERAL ELECTRIC

LIGHT MILITARY ELECTRONIC EQUIPMENT DEPARTMENT
FRENCH ROAD, UTICA, NEW YORK

AVIATION CALENDAR

Oct. 15-19—Second Annual Worldwide Conference of USAF flying safety officers, conducted by USAF Flight Safety Research, Keesler AFB, Biloxi, Miss.

Oct. 15-Nov. 21—Short course for aerial applicators, Ohio State University, in cooperation with Ohio Aviation Board, Ohio State University School of Aviation, Columbus, Ohio.

Oct. 16—Ninth Annual Airport Development and Operation Conference, sponsored by N. Y. State Dept. of Commerce and N. Y. Aviation Trades Assn., Hotel Onondaga, Syracuse, N. Y.

Oct. 16-Nov. 2—Tenth Air Transportation Institute, American University, Washington, D. C.

Oct. 17-19—Annual Indiana Aviation Conference, sponsored by Indiana Aviation Trades Assn. and Indiana Airport Officials Assn., Turkey Run State Park, Marshall, Ind.

Oct. 18-19—Plastics Engineering Institute, University Extension Division, University of Wisconsin, Madison 6, Wis.

Oct. 22-23—Fall Meeting, Assembly of the Radio Technical Commission for Aeronautics, Marrott Hotel and CAA Technical Development Center, Indianapolis.

Oct. 23-25—National Business Aircraft Assn. Ninth Annual Meeting and Forum, McAllister-Columbus Hotels, Miami, Fla.

Oct. 25-26—Aircraft Electrical Society Annual Equipment Display, Pan Pacific Auditorium, Los Angeles, Calif.

Oct. 25-26—Second Annual Technical Meeting, Institute of Radio Engineers Professional Group on Electron Devices, Shoreham Hotel, Washington 25, D. C.

Oct. 29-30—Third Annual East Coast Conference on Aeronautical and Navigational Electronics, Fifth Regiment Armory, Baltimore, Md.

Oct. 31-Nov. 1-2—1956 Annual Meeting and Exhibit, Society for Experimental Stress Analysis, Deshler-Hilton Hotel, Columbus 1, Ohio.

Nov. 1-2—20th Anniversary National Time and Motion Study and Management Clinic, sponsored by Industrial Management Society, Sherman Hotel, Chicago.

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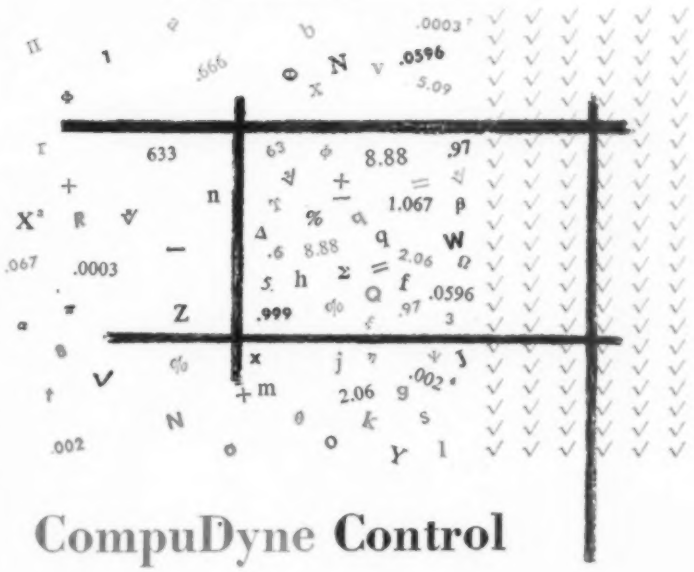
ON AERONAUTICAL RESEARCH AND TEST FACILITIES



CompuDyne Control

increases data *output* and *validity*

CompuDyne Control Systems establish the constants necessary for *valid* aeronautical test work . . . regulate the most severe process transients. Employing computor-dynamic techniques, they attain steady-state conditions . . . step, ramp or otherwise program variables . . . at higher speeds, with greater accuracy than ever before possible.

Time saved in attaining test conditions is a vital factor in data output. Accuracy is essential for data validity.

Prior to manufacture, CompuDyne Control Systems are pre-tested by means of analog computor studies. You know exactly what performance to expect. CompuDyne Control Systems are designed, built and installed within your facility . . . from conception to operation . . . on a guaranteed performance basis.

INFORMATIVE NEW BULLETIN entitled, "VALID DATA . . . economically produced by dynamic process control" will be sent to you upon request. Write or telephone.

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Aircraft Engines & Components
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Blowdown Wind Tunnel
Continuous Wind Tunnel
Dynamic Structural Loading
Altitude Chamber
Compressor Surge

Representatives in major cities

cdc control services, inc.
400 SOUTH WARMINSTER ROAD • HATBORO, PA.

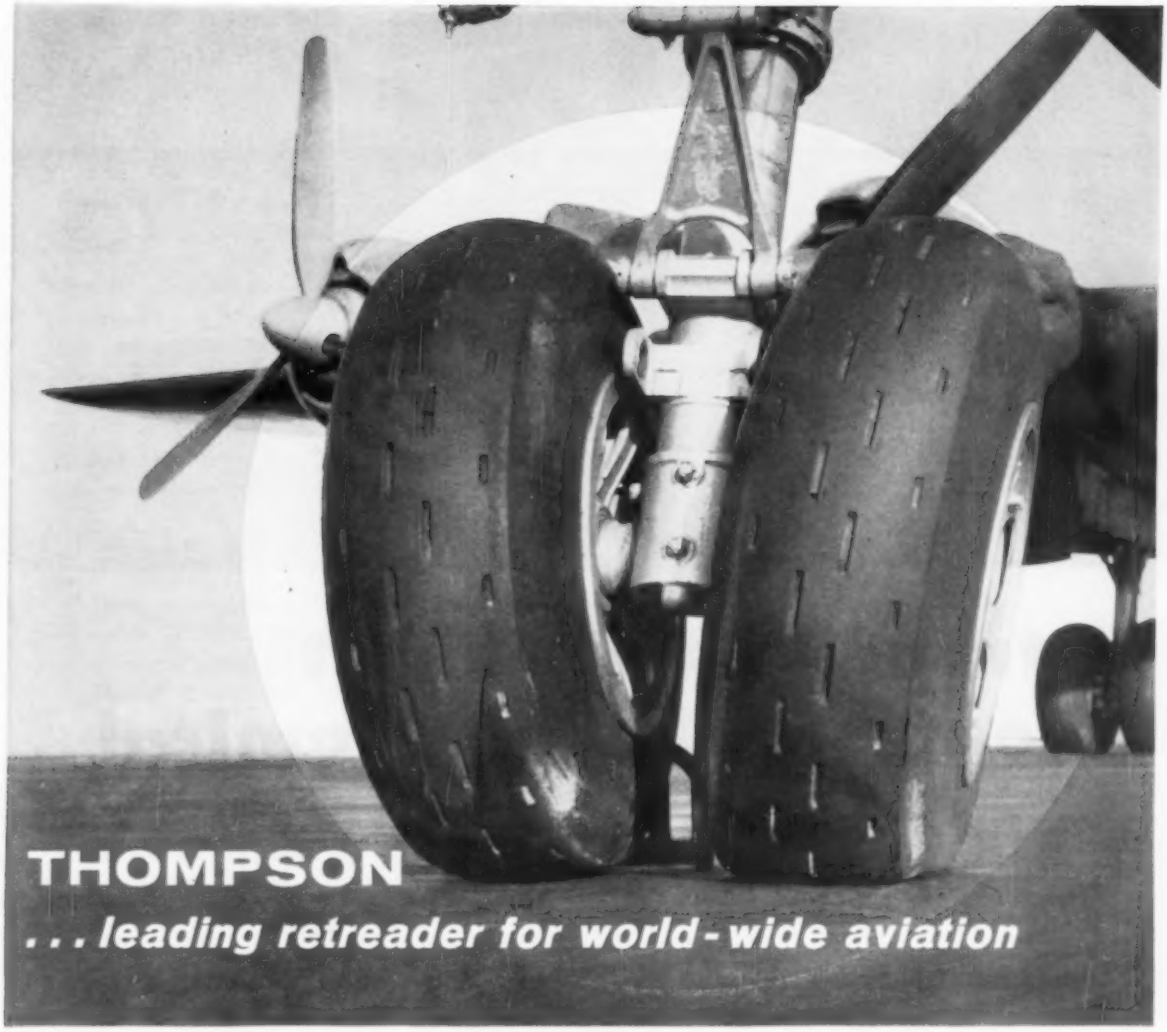
Every wolf would like to eat a porcupine. Few of them get around to it. What makes the porcupine's meat so good, of course, is the fact that he doesn't have to do any running. Wolves, by and large, are an ill-tempered, frustrated lot, while you almost never see a neurotic porcupine. He figures it's cheaper to carry a quiver full of arrows than to get ulcers from hiding. There are predators of the sky, too, and helping keep them in a state of frustration is REPUBLIC'S job building THUNDER-CRAFT.

25 YEARS

REPUBLIC AVIATION

FARMINGDALE, LONG ISLAND, N. Y.

Designers and Builders of the Incomparable **THUNDER-CRAFT**



Thompson is the one retreading organization geared to serve local, trunk and international airlines. With three large plants and conveniently located delivery offices, Thompson provides prompt and efficient retreading service for airlines the world over. Every transcontinental airline and most inter-continental airlines use Thompson treads. Unsurpassed for safety, long wear and economy, Thompson treads are used more than all other retreads.

MODERN AIRLINERS FLY THOMPSON
EXTRA-LANDINGS RETREADS

THOMPSON AIRCRAFT TIRE CORPORATION

18th and Minnesota Streets San Francisco 7, California MIssion 7-7320	International Airport Miami 48, Florida TUxedo 8-1681	530 Ray Street Freeport, New York FReeport 9-8100

C-133A, giant military turboprop transport now in production at Douglas Long Beach Division, features silicone-glass laminate ducts under the engine cowls for greater serviceability and economy of fabrication. Made in Douglas' own shops, using Dow Corning 2106 Resin and glass cloth, ducts must withstand 15-minute direct flame test.

strong • lightweight
heat stable • economical
silicone-glass

Silicone-glass laminates made with Dow Corning 2106 Resin retain a higher strength-to-weight ratio at high temperatures than many light metals. Silicone-glass laminate ducts have the flexural strength to withstand jarring punishment, like serious engine backfiring, that can cause stainless steel ducts to split. Moreover, large or complicated shapes are easily and more economically molded with silicone-glass laminates. Simple plaster forms replace expensive dies and molds normally required for fabricating metal parts.

. . . But this is just part of the story. Write today for FREE brochure giving full particulars on versatile silicone-glass laminates made with "2106" and other Dow Corning silicone resins.

first in silicones

DOW CORNING CORPORATION,

ATLANTA BOSTON CHICAGO CLEVELAND DALLAS DETROIT LOS ANGELES NEW YORK WASHINGTON, D. C. (SILVER SPRING, MD.)
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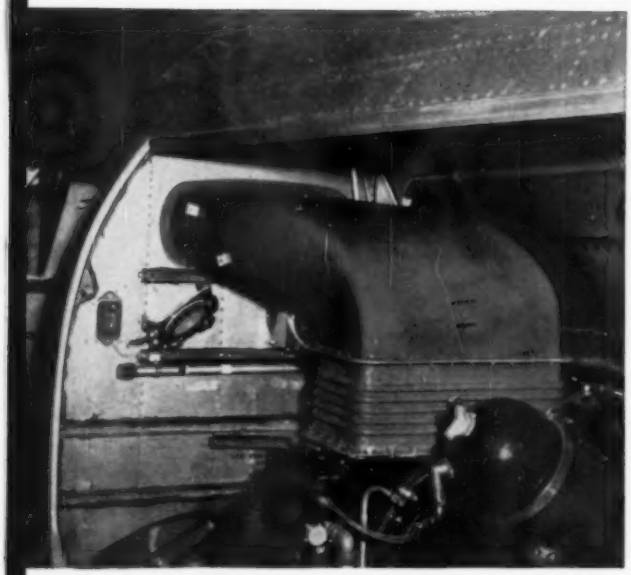

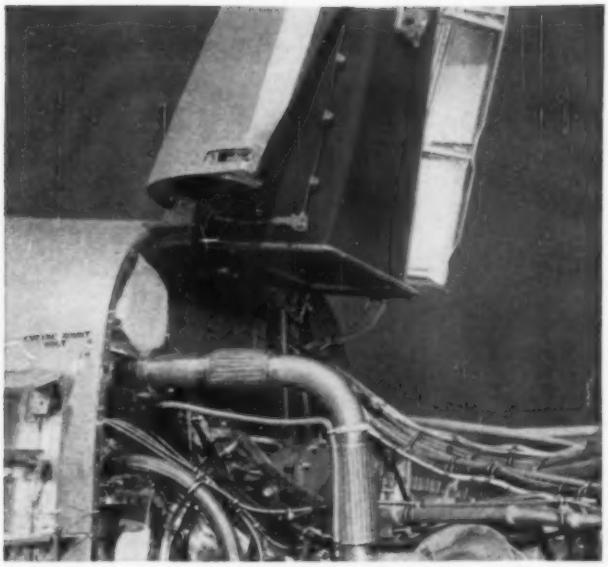

These silicone-glass laminate ducts are vital components of the heating and air conditioning system of the C-133A. Tricky shapes, difficult and expensive to form in metal, are easily fabricated with a silicone-glass laminate. Note: Convoluted section in photo at left is made of Silastic*, Dow Corning's silicone rubber . . . It stays flexible at temperatures ranging from —130 to 500 F.

*TM REG. U.S. PAT. OFF.

laminates

made with DOW CORNING 2106 RESIN

typical properties of silicone-glass laminates

. . . DOW CORNING 2106 RESIN ON 181 GLASS CLOTH, 1/8 INCH THICK

Flexural Strength—
50,000 psi at 77°F.
46,000 psi at 77°F after 100 hours at 500°F.
20,500 psi at 500° F after 200 hours at 500°F.
Nonflammable
Thermal conductivity — 1.10 btu/hour/square foot/inch/°F.
Specific gravity — 1.93 at 23°C.

NEW BROCHURE . . . *FREE!*

Send coupon today for your copy, including a list of leading fabricators of silicone-glass laminates.

Midland, Michigan

Dow Corning Corporation, Dept. 0910C
Midland, Michigan

Please send me your new brochure on silicone-glass laminates.

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COMPANY _____

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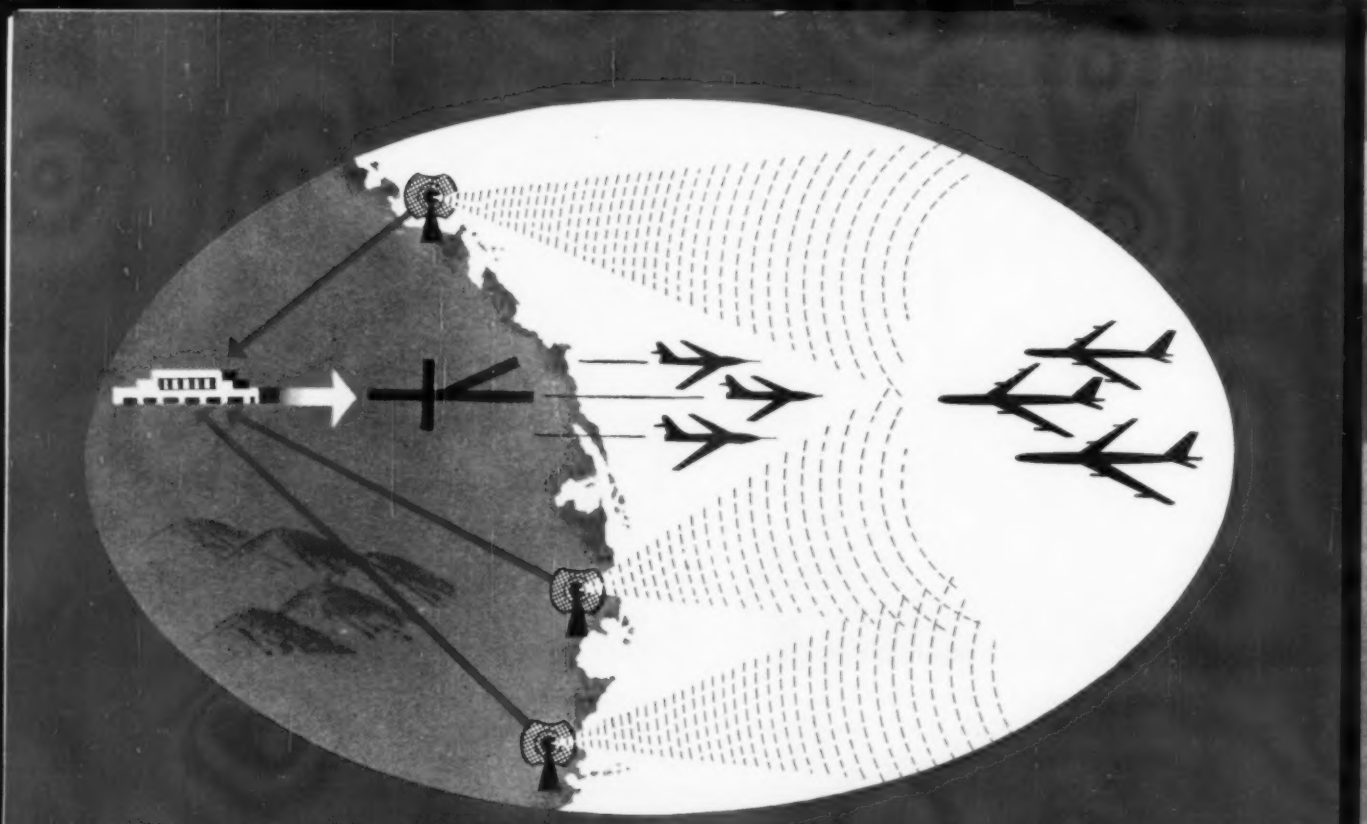

SAGE

SEMI-AUTOMATIC GROUND ENVIRONMENT

speeds security . . . with the help of Burroughs computation

Briefly, SAGE does this: employs radar and electronic digital computers to detect and identify approaching enemy aircraft; determines appropriate defensive measures such as antiaircraft weapons, missiles, or intercepting planes; guides missiles and interceptors to the target and then returns planes to their home base.

Burroughs has the SAGE job of helping to speed the correlation and translation of warning data through automatic computation. This entails research, development, prototype design and engineering, production, installation, training and field maintenance.

Here is just one of many significant Burroughs contributions to defense in the areas of instrumentation, control systems, communications, electronic computers, data processing. And on the basis of our proved skills, facilities and experience, we welcome further inquiries regarding defense contracts. Call, write or wire Burroughs Corporation, Detroit 32, Mich.

INTEGRATED BURROUGHS CORPORATION DEFENSE FACILITIES INCLUDE:

Burroughs Corporation plants in Detroit and Plymouth, Michigan
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Control Instrument Company, Brooklyn, N. Y.
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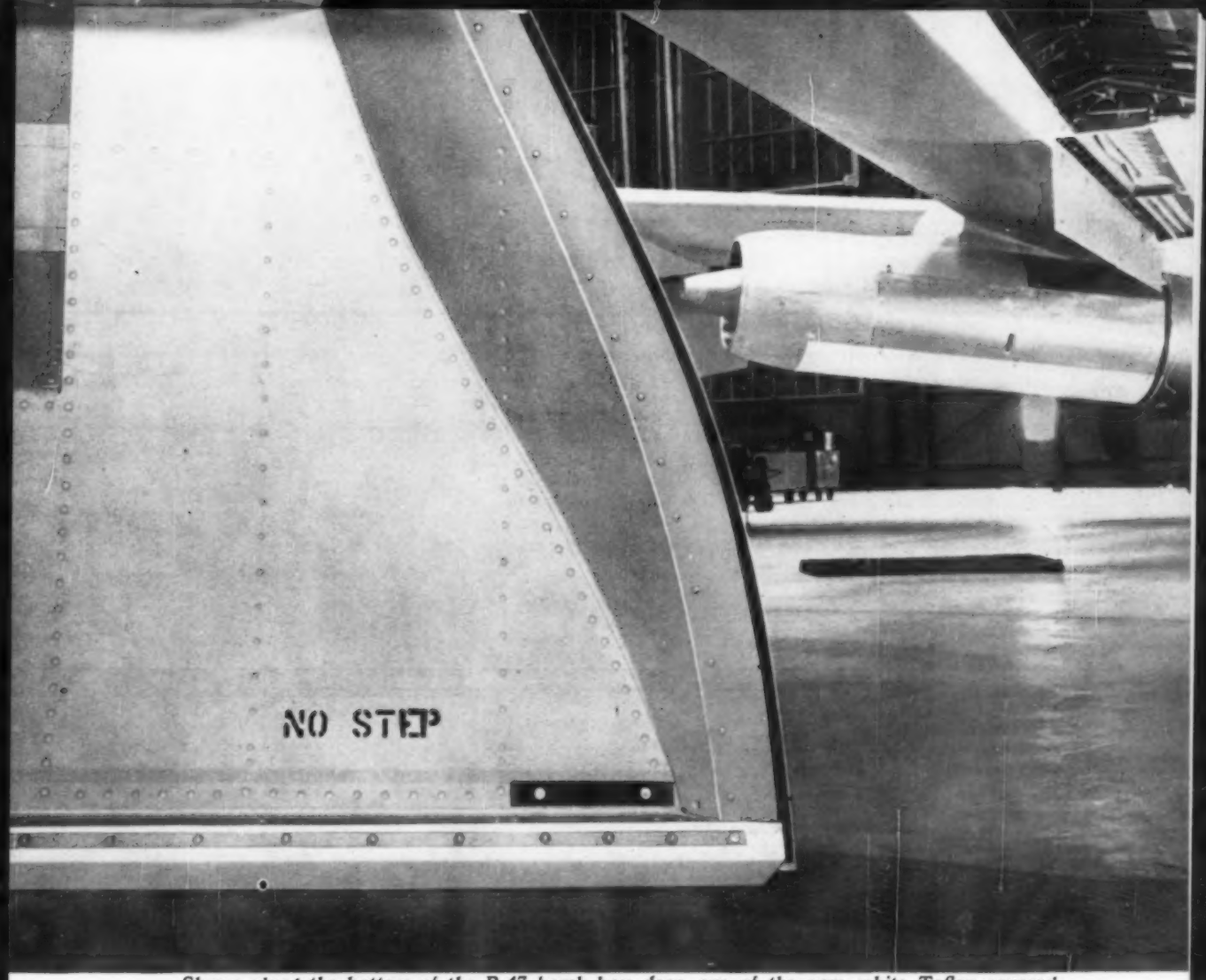
Electronic Tube Division, Plainfield, N. J.
The Todd Company, Inc., Rochester, N. Y.

Burroughs

The Foremost Name in Computation

Looking to future expansion, Burroughs invites inquiries from qualified engineers.



Shown along the bottom of the B-47 bomb bay door, one of the new, white Teflon covered silicone rubber seals developed by CHR.

THIS BOMB BAY DOOR SEAL COMES HOME

Modifications of the B-47 fleet include this new bomb bay door seal. In this seal, developed and produced by CHR, a heavy Teflon film is securely bonded to white silicone rubber in the same cross-section and lengths as the original organic rubber seals.

Result of the new construction... a temperature range of −100°F to 500°F—a slick surface that sheds snow and ice — an effective seal against moisture. More important, this new seal comes home time and again after being buffeted severely when the doors are opened and closed in high speed flight. The Teflon film adds ruggedness to the seal. Its slippery surface allows the mating seals to slide together readily instead of binding and cracking.

CHR Teflon covered seals are being used on other planes where sliding action or resistance to fuels and synthetic lubricants are required.

Our experience in helping designers with aerodynamic, body, canopy and hatch seals utilizing all forms of silicone rubber and reinforcing fabrics or Teflon can be put to work to help you.

cohrlastic aircraft products • seals • de-icers • anti-icers
coated fabrics • silicone rubber products

CHR

THE CONNECTICUT HARD RUBBER CO.

407 EAST STREET, NEW HAVEN 9, CONN.

LOS ANGELES • ST. LOUIS • SEATTLE

New simplified approach to temperature control has superior reliability

Edison Reverses Trend Toward Complexity In Aircraft Accessory Systems

Proved in service on the Douglas C-124 Globemaster, the Convair delta wing F-102, the Boeing B-50 and many other operational aircraft, the Edison simplified temperature control now reverses the trend toward complexity in aircraft accessory systems.

Compact and lightweight, this highly reliable temperature control uses only standard electro-mechanical components—no electronic equipment. Its design simplicity eliminates costly maintenance training. The instrument's checkout procedure is familiar to any electrician.

This basic control teams up with the rugged Edison Fire Detector Cable or with any of Edison's accurate Resistance Temperature Detectors to warn of fire in engines and baggage areas or to signal dangerous temperatures in bearings, heating ducts or oil lines. Simultaneous or selective temperature indication is optional on all overheat detecting systems using RTD's.

Edison field engineers with years of aircraft experience are located in Ft. Worth, Dayton, Glendale, Chicago and West Orange. They will gladly analyze your temperature control problems and recommend action. Just write any of these offices and let us know your requirements.

Thomas A. Edison

A GREAT NAME CONTINUES GREAT NEW ACHIEVEMENTS

Thomas A. Edison

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INSTRUMENT DIVISION • 49 LAKESIDE AVENUE • WEST ORANGE, NEW JERSEY

HALF A MILLION STRATOPOWER® HYDRAULIC PUMPS

65F SERIES
Fixed displacement—.5 to 3.0 gpm at 1500 rpm. Speeds to 10,000 rpm and over. Pressures to 3000 psi.

65W SERIES
Variable delivery—.25 to 10 gpm at 1500 rpm. Pressures to 3000 psi.

66W SERIES
Variable delivery—2 to 6 gpm at 1500 rpm. Pressures to 3000 psi.

Half a million Hydraulic Pumps . . . built to the most exacting standards—tested beyond any question, proven in service on military, commercial and civilian aircraft! Back of every STRATOPOWER Hydraulic Pump is vast productive capacity with the skills and experience to deliver "precision in volume." When your requirement demands the unavailable in size, weight, speed, temperature, capacity, pressure or operational ceiling—look to STRATOPOWER to develop it for you! For full information on new STRATOPOWER developments write to Dept. 720

WATERTOWN DIVISION
THE NEW YORK AIR BRAKE COMPANY
STARBUCK AVENUE • WATERTOWN • N. Y.

Bendix Leader in All Types of Ignition . . .

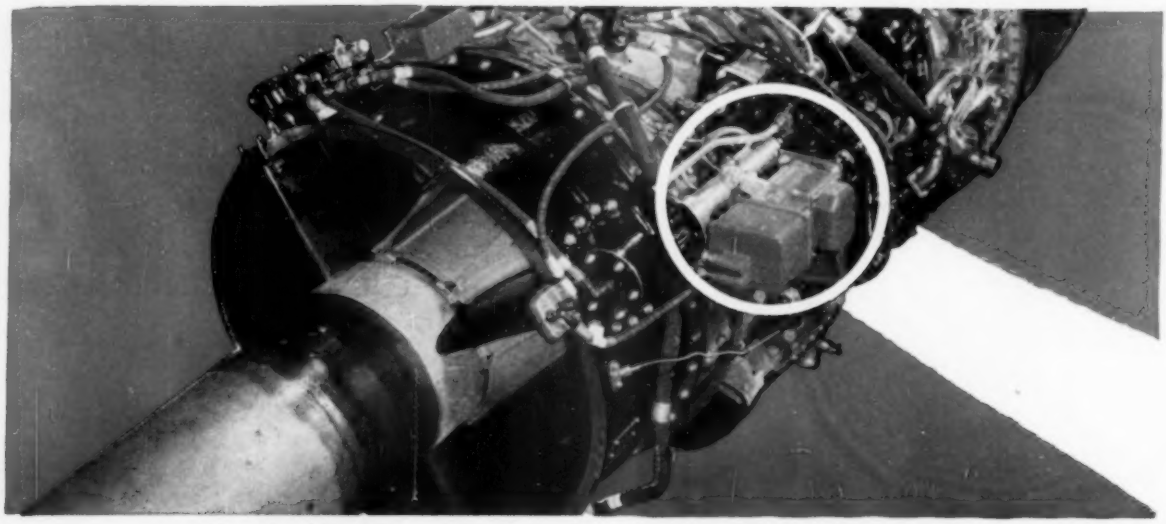
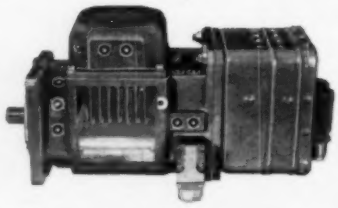


Illustration shows Bendix TMGLN *system installed on the Curtiss-Wright J65W-4 Jet Engine*

Offers the first self-contained JET IGNITION SYSTEM



This TMGLN *jet ignition system has been performance proven and is currently in production on Curtiss-Wright J65W-4 Engines for carrier based aircraft.*

Bendix* proudly announces the first self-contained jet engine ignition system. This system generates within itself the electrical energy required to fire the engine igniter plugs. This unique system, known as the TMGLN jet ignition system, employs a magneto type alternating current generator which allows the ignition system to operate independently of an outside source.

Here is just another example of the ability and versatility of Bendix to come up with the best solution to any and all jet ignition problems.

Whether your requirements call for the TMGLN self-contained system or the conventional battery energizing type of jet ignition, you'll do better with Bendix—The Most Trusted Name in Ignition. *TRADEMARK

SCINTILLA DIVISION,
BENDIX AVIATION CORPORATION
SIDNEY, NEW YORK

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Bendix
SCINTILLA DIVISION
Bendix
AVIATION CORPORATION

Getting specific about gravity!

Falling apples fascinated Sir Isaac Newton. No doubt he enjoyed a few of them while devising his famous gravitational formulas. Newton's concern was with what came down, whereas aviation engineers today are primarily concerned with what goes up. Even so, the gravitational challenge is the same.

A jet plane, intercontinental missile—or anything that moves — usually leaves the design stage too heavy for optimum performance. To be specific — the specific gravity of the material of construction is too high.

Now, with Titanium, the design engineer can capture the strength of alloy steel at barely more than half the weight. What's more, Titanium is unaffected by most corrosives . . . and is impervious to the deadly attack of sea water and marine atmospheres. Its coefficient of expansion is low . . . and it can withstand long-time operating temperatures as high as 1000°F.

All types of Titanium mill products, from foil to seamless tubing, are made by TMCA. With production going up and prices going down, now is a good time to design with Titanium. Technical literature on Titanium is available just by asking.

. . . FIRST IN **Titanium**

TITANIUM METALS CORPORATION OF AMERICA, 233 Broadway, New York 7, N.Y.

PLANE FAX

by STANDARD OIL COMPANY OF CALIFORNIA

300-mile flight wins $1,000,000 job

Four hours before the deadline for placing bids on a million-dollar Nevada State road construction job, A. D. "Andy" Drumm Jr. took off from his home airport at Fallon, Nevada. In 3½ hours he had covered 300 miles, flown over the future road site to estimate the work involved, landed at Carson City and placed the low bid.

"Bumpy low-level flying, frequent take-offs from gravel strips, steep climbs in hot weather — we do it all," says Mr. Drumm, who is owner of the Silver State Construction Company. "But in several thousand hours in the air, we've never had any engine trouble, using RPM Aviation Oils. In fact, we usually put 1000 hours on a plane with only regular maintenance, then trade it in while it's still in top condition. When we do overhaul an engine, we've always found 'RPM' has kept it clean and held wear very low.

"This lets us get full power from Chevron Aviation Gasoline right up to trade-in time. Even on our rough, short strips it gets our Bonanza's and AT-6's upstairs with plenty of room to spare. Leans out for economy in cruising, too. It's the best fuel we've ever found."

TIP OF THE MONTH

With so much flying in Nevada's turbulent air, Mr. Drumm's planes are equipped with G-meters. His advice—*slow down* when bumps register plus-2 or minus-1 G's, or whenever it gets really rough.

CHEVRON AVIATION GASOLINE

RPM AVIATION OIL

We take better care of your plane

T.M.'S "RPM," "CHEVRON," "PLANE FAX," REG. U. S. PAT. OFF.

WHITTAKER GYROS

100% INSPECTION TESTS MEAN ACCURACY AND DEPENDABILITY!

Designed by engineers and built by technicians who have worked together for more than a decade, Whittaker Gyros offer unsurpassed performance.

Stainless steel construction (including gimbals), meticulous care, continuous testing of components and assemblies, plus 100% inspection tests of components, have resulted in an overall customer rejection of less than 2% — month after month.

TYPE R130
RATE GYRO UNIT
(case removed)

The R130 type instrument is basically a single degree of freedom gyro incorporating an alternating or direct current powered rotor, air dash pot damping, and spring restraint.

The gyro may be furnished either hermetically sealed or with a removable dust-proof cover.

The R130 series rate gyro is available with the following methods of indication :

1. Potentiometer
2. Microsyn
3. Commutator
4. Switching Contacts

TYPE G110
SLAVED VERTICAL GYRO UNIT
(case removed)

The G110 type vertical gyro is basically a two degree of freedom gimbal system incorporating an alternating or direct current powered rotor and an electrical gravity sensing erection system. The gimbal travel is restricted to a maximum of ±80 degrees on inner and outer gimbals.

The gyro may be furnished with either a hermetically sealed or removable dust-proof cover.

The gyro is depicted with separate glass sealed terminals but can be furnished with any available sealed connector.

The G110 series gyro is available with the following methods of indication:

OUTER GIMBAL	INNER GIMBAL
1. Potentiometer	1. Potentiometer
2. Commutator	2. Commutator
3. Synchro	
4. Resolver	

TYPE G120 **FREE GYRO UNIT** (case removed)

The G120 type free gyro is basically a two degree of freedom gimbal system, incorporating an alternating or direct current powered rotor and a manual or electrical caging system.

The gyro may be furnished with either a hermetically sealed or removable dust-proof cover.

The gyro is depicted with separate glass sealed terminals but can be furnished with any available sealed connector.

The G120 series gyro is available with the following methods of indication:

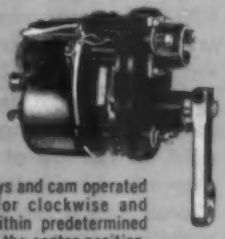
OUTER GIMBAL	INNER GIMBAL
1. Potentiometer	1. Potentiometer
2. Commutator	2. Commutator
3. Switching Contacts	3. Switching Contacts
4. Synchro	
5. Resolver	

TYPE G140
3-AXIS TELEMETERING GYRO
(case removed)

The G140 type gyro consists basically of two, two degree of freedom gimbal systems, incorporating alternating or direct current powered rotors. A direct current powered caging and uncaging system is provided.

The two gyros are mounted in a single frame in such a manner that output indication is obtained about three mutually perpendicular axes.

TYPE S21A
ELECTRIC SERVO
(case removed)



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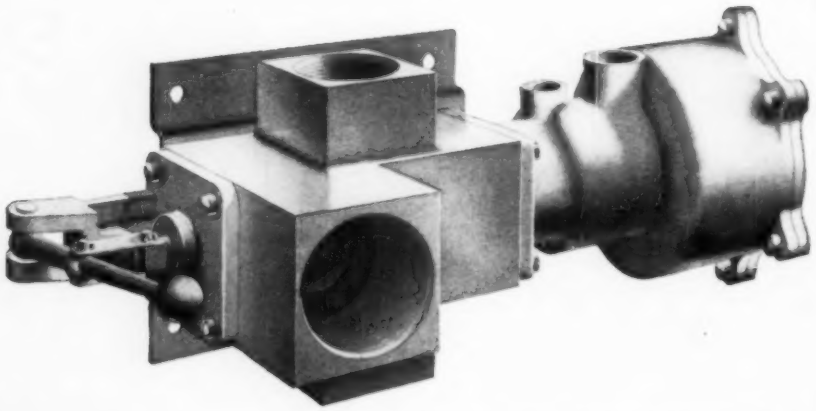

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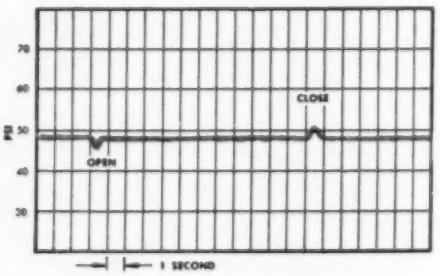

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OCTOBER 15, 1956

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COVER: Temco Aircraft Corp.'s prototype TT-1 trainer banks steeply near the company plant at Dallas, Tex. Powered by a Continental YJ-69-T-9 turbojet engine of 920 lb. thrust, the light trainer permits pilot familiarization over a wide speed range. Lightness and simplicity combine to make a low-cost airplane, and a Navy order for 14 has been received. Temco developed the trainer with its own funds (detailed story is on page 98).

67,859 copies of this issue printed

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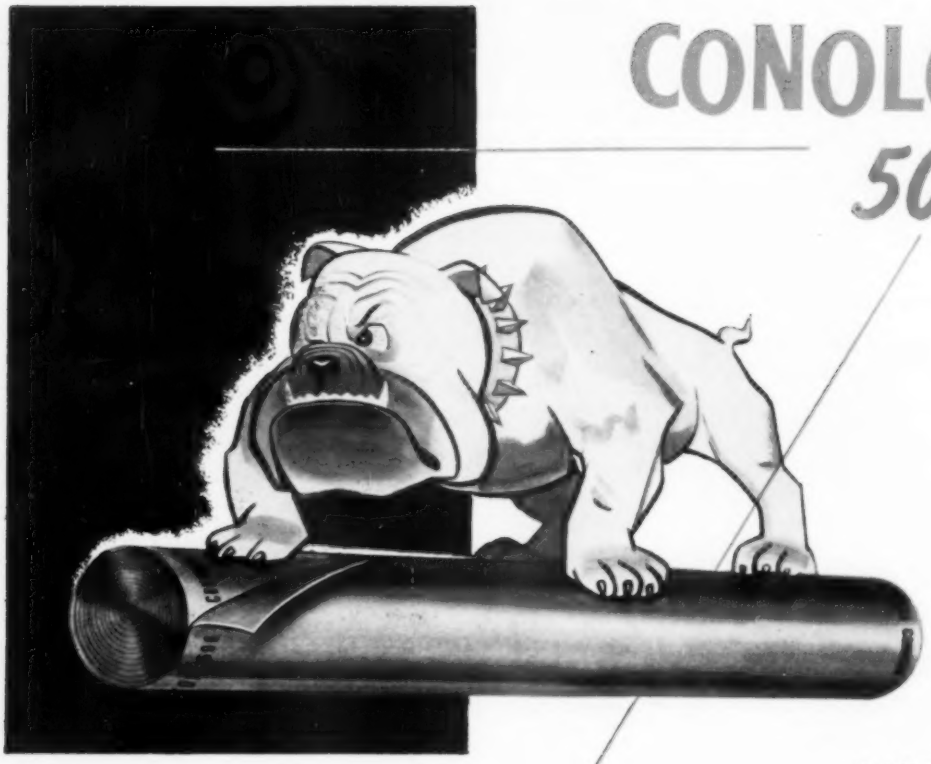

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EDITORIAL

European Production Pool

Not long ago we spent part of an extremely interesting afternoon with Georges Glasser, 49 year old president of the French Sud Ouest Aviation Inc., in his Paris office. Mr. Glasser is an engineer by profession, a graduate of the famous French Ecole Polytechnique and served during World War II as a military engineer. Now in addition to running an organization of 8,000 workers in five factories building jet bombers and helicopters and rocket-powered interceptors, he also is president of the French Aircraft Industries Association. In this latter capacity Mr. Glasser has some interesting proposals for the future of the aircraft industry in Europe.

Like so much current realistic thinking on European problems, Mr. Glasser's proposals aim at minimizing the economic restrictions of national political boundaries and planning on a broad continental basis for the entire West European economy. As a major premise in his plan for the future of aircraft manufacturing Mr. Glasser believes it is time the United States and the North Atlantic Treaty Organization recognize the fact that the European aircraft industry has recovered from its post-war slump and is now fully capable of producing first line military equipment specifically designed to meet European defense needs. Recognizing the need for the United States to fill the post-war gap with its own aircraft given under this military aid program and the generosity of this policy, Mr. Glasser believes a basic reappraisal of this policy, in light of Europe's current technical capacity, economic problems and defense requirements, is urgently needed.

Tailored to NATO

Mr. Glasser urges an end to the flow of military aircraft furnished from U.S. plants and the beginning of a policy aimed at enabling the European aircraft industry to develop a strong research and development program backed by sufficient production in types of equipment that are tailored specifically to NATO defense requirements and are not duplicating American areas of activity such as the heavy transport and bomber fields.

Mr. Glasser recognizes that European air defense requirements are not large enough to keep all the aircraft firms in Europe busy building their own designs for their own countries. To solve this problem Mr. Glasser believes a common European aircraft production pool is necessary to supply all NATO countries with standard equipment.

Competition would be confined to the area of technical development and design. Once the best design was chosen, its production should be sub-contracted among European firms who have the capacity to build its components regardless of nationality, Mr. Glasser believes. He points out that this has already worked well in several cases such as the Mystere fighter which was designed by Dassault and now has major subassemblies built by Sud Est and Sud Ouest in addition to the designing firm. On its Vautour light bomber Sud Ouest has arranged major subcontract with a Belgian firm.

Design Competition

In the current NATO lightweight attack plane competition the three competitors—Dassault, Breguet and Fiat—have agreed to pool the production regardless of which one wins the design competition. Mr. Glasser suggests that this type of operation could be extended to the rising West German aircraft industry.

By following this plan Mr. Glasser believes it will be possible for each firm to maintain a strong and continuous line of technical development without the time losses now incurred when loss of a technical competition means reduced production and employment cutbacks.

In answer to a question on the vulnerability of the European aircraft industry in contrast to overseas manufacturers, Mr. Glasser pointed out that the Europeans would be building primarily for the NATO force in being which is designed to act as a deterrent to any aggression from the East. Any contribution it made to this force in being would be valuable regardless of what happened after the outbreak of a major nuclear war.

There is no question that the United States military aid program cannot continue indefinitely in the same manner and scope that it has operated during the post-war decade. The American taxpayers will welcome any plan that affords some relief from the crushing military expenditure load they are now carrying. We think Mr. Glasser's proposal deserves careful study in the councils of NATO and the parliaments where NATO policy is formulated.

—Robert Hotz

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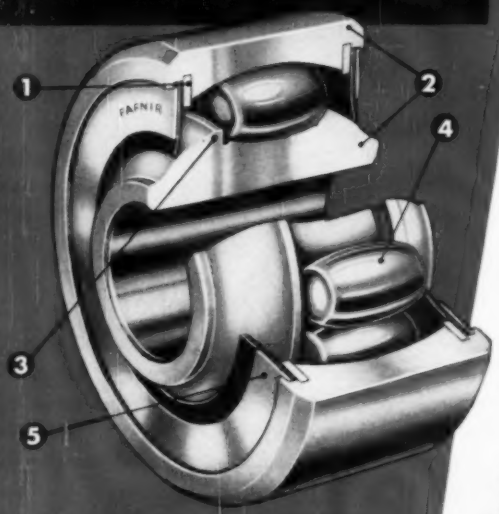

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DSRP4	.2500	.9014	.625	.464	.404	.005	.032	12	.1514	3025	.06
DSRP5	.3125	1.2500	.812	.656	.515	.015	.032	11	.2303	7350	.16
DSRP6	.3750	1.4375	.937	.750	.564	.015	.032	11	.2681	9600	.24
DSRP8	.5000	1.6875	1.000	.812	.775	.015	.044	12	.3023	12500	.36
DSRP10	.6250	1.9375	1.125	.937	.869	.015	.044	14	.3016	17700	.55
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FAFNIR AIRCRAFT BEARINGS

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WHO'S WHERE

In the Front Office

Robert R. Miller, vice president and general manager, elected a director, Northrop Aircraft, Inc., Hawthorne, Calif.

E. Finley Carter appointed director of Stanford Research Institute, Menlo Park, Calif. Mr. Carter also was named to the Institute's board.

John C. Virden, president, Eaton Manufacturing Co., Cleveland, Ohio. Mr. Virden succeeds **Howard J. McGinn** who continues as board chairman and member of the executive committee.

G. W. Kelch, president, Ingersoll-Humphryes Division (Mansfield, Ohio), Borg-Warner Corp., Chicago, Ill.

L. Nevin Schwien, executive vice president-engineering and production, Burton Manufacturing Co., Santa Monica, Calif.

Albert S. Burgoyne, vice president-manufacturing, E. W. Bliss Co., Canton, Ohio.

George Friedl, Jr., vice president, Litton Industries, Inc., Beverly Hills, Calif.

Stephen H. Badgett, vice president-operations, Aeronca Manufacturing Corp., Middletown, Ohio. Also: **R. F. Hermes,** vice president-projects branch, and **W. W. Ford,** vice president-technical service division.

William H. Miller, vice president-manufacturing, Cook Electric Co., Chicago, Ill.

J. Paul Walsh, deputy director of Project Vanguard, Department of Defense, Washington, D. C.

Horace B. McCoy, administrator, Business and Defense Services Administration, Department of Commerce, Washington, D. C.

Rear Adm. Allen Smith, Jr. will become director, Naval Aviation Safety Center, Naval Air Station, Norfolk, Va.

Honors and Elections

Secretary of the Navy **Charles S. Thomas** received the National Safety Council's Award of Honor which is the Council's highest award for prevention of accidents.

Dr. William F. Ballhaus, chief engineer, Northrop Aircraft, Inc., elected chairman of The Aircraft Industries Association's Guided Missile Committee for the coming year. Dr. Ballhaus succeeds **Edwin A. Speakman,** vice president and general manager, Fairchild Guided Missiles Division, Wyandanch, N. Y.

Republic Aviation Corp. has received the Department of Defense Reserve Award Certificate for outstanding support of the nation's reserve program. USAF presented the award.

Justus T. Vollbrecht, president of Energy Control Corp., elected national president of the Instrument Society of America.

Vern I. McCarthy, Jr., vice president of Vulcan Containers, Inc., Bellwood, Ill., will serve a six months appointment as deputy director of the Containers and Packaging Division of the Business and Defense Services Administration, Department of Commerce, Washington, D. C.

(Continued on page 94)

INDUSTRY OBSERVER

► USAF awarded Northrop Aircraft Inc., a $26 million developmental production contract for the SM-62 Snark intercontinental guided missile. Pereira & Luckman have a Northrop contract for architectural and engineering structural design of a checkout building and test cell for the complete Snark missile system. Acoustical design and fabrication of noise control equipment for the test facility have been awarded to Industrial Acoustics Co., of New York, through Mid-Air Equipment Corp.

► **Pratt & Whitney Aircraft has a new Navy development contract for the J58, a split compressor turbojet believed to be a successor to the J75, with thrust beginning at about 20,000 lb.**

► USAF is on the verge of buying a service test quantity of Douglas DC-8 jet transports for operational service with the Military Air Transport Service. The Air Force order is expected to be for long-range versions of the DC-8 with Pratt & Whitney J75 engines.

► **Fairchild's new Operations Research Division (AW Sept. 3, p. 23) will be expanded during the next few months, primarily to seek opportunities from Army's expanding aviation research and development program. So far, the offices at Alexandria, Va., have been manned by a skeleton staff.**

► Navy, reviving its interest in the Pratt & Whitney J52, a 7,500-lb. split-compressor turbojet engine, will definitely use it in one of its aircraft projects. This will enable Pratt & Whitney to get sufficient development and service experience for the commercial version of the J52 (the JT8).

► **Douglas offering two versions of its DC-9 medium-range jet transport (AW Sept. 3, p. 26). Shorter-range version, aimed at stage lengths of between 250 and 500 miles, will be powered by the Pratt & Whitney J52; longer-range version, aimed at stage lengths of over 500 miles, will use commercial version of General Electric J79 turbojet (the CJ805).**

► Canadair's CL-128 maritime reconnaissance version of the Bristol Britannia scheduled to make its first flight next spring. The CL-28 will be powered by four Wright turbo-compound engines, replacing the Bristol Proteus turboprop on the original Britannia.

► **Convair F-106 tentatively scheduled to go to Edwards AFB, Calif., in December, with the first flight planned for January.**

► Republic Aviation's F-103 interceptor has unusual air intake on underside of fuselage. Scoop has concave outline with bottom portion projecting sharply forward.

► **Canadair developing a new primary jet trainer for the Royal Canadian Air Force. It will be powered by the Rolls Royce RB. 106, a 3,000-lb. thrust turbojet with an extremely high thrust-weight ratio.**

► General Electric T58 gas turbine passed its 50 hr. qualification test. Two Sikorsky HSS (S-58) helicopters will be fitted with T58 engines and are expected to make first flights late November or early December. The T58-powered HSS originally was scheduled to fly early next year. A Vertol H-21 also is being equipped with the T58.

► **Zenith Plastics Co., Gardena, Calif., a subsidiary of Minnesota Mining and Manufacturing Co., producing 40 sets of reinforced plastic wings for use on the Goose guided missile being built by Fairchild Engine & Airplane Corp.**

► Nagler Helicopter Co., New York, modified its single-place co-axial testbed, primarily to eliminate vibration and blade flutter. New main rotor is longer, with chord increased from three to seven in. Lower rotor, located beneath fuselage, has had span increased from seven to 8.3 ft. and uses two blades in place of former three blade layout. Craft has a total of approximately 10 flight hours.

Combat commuter –

at 8 second intervals

In recent tests duplicating actual assault landings, Fairchild C-123's gave dramatic evidence of performance under combat conditions.

The target – a rough, ungraded field – was ringed by "hostile" forces. Heavily laden, the C-123's approached the field at 500 ft. altitude – too low for heavy A.A. guns, too high for small-arms fire. Just short of their touchdown point, the highly maneuverable assault transports swept down, flaring out just as they flashed over the clearing's edge. Two minutes later, twelve C-123's had rolled to a halt – troops and trucks were fanning out to their assigned positions. The C-123's had landed at *8 second intervals!*

This dramatic demonstration of pilot and crew proficiency was made possible by C-123 maneuverability, short field performance and utter reliability – all three, features of Fairchild aircraft designs.

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Washington Roundup

About-Face on X-2

In a sudden about-face on his own public relations officers, USAF Secretary Donald A. Quarles last week disclosed that Capt. Milburn G. Apt set an unofficial world's speed record before he was killed during his first powered flight in the Bell X-2 research plane (AW Oct. 8, p. 32). Even after the advance text of a speech Quarles was to deliver before the National Guard Assn. in Spokane, Wash., was distributed in the Pentagon, his staff was telling reporters, "Anything about the X-2 is classified."

On top of this, the new speed record—reported to be well in excess of 2,000 mph.—apparently had not been disclosed to the manufacturer. Presumably, the X-2's instrument records were under lock and key at Edwards AFB and would be examined in top USAF offices before Bell could see them.

In addition to a frustrated press, who were denied the information that was being used in the Secretary's speech, the Air Force itself has a substantial corps of officers and civilians who feel that the entire handling of the X-2 speed and altitude records and the subsequent tragedy has done a grave injustice to the aircraft and pilots who flew it.

New Rules For Renegotiation

The Renegotiation Board has issued a series of new regulations to implement changes in the renegotiation law enacted during the last session of Congress and to clarify other regulations. Subjects covered by the regulations include:

- **New provision exempting contractors** with less than a $1 million-a-year sales volume. Through Fiscal 1956, the floor is $500,000.
- **New provision allowing** a two-year carry-forward of losses. Previously, contractors have been permitted to carry forward losses to offset profits for only one year.
- **Exemption of contracts** with Commerce Department (Civil Aeronautics Administration) and the National Advisory Committee for Aeronautics.
- **Clarification of regulations** dealing with factors to be considered in the allowance of profits on subcontracts. (The policy of the board is to give "favorable treatment" concerning subcontracts but not necessarily allow a rate of profit equal to that which might have been realized under a prime contract).
- **Clarification of regulations** on the exemption from renegotiation of standard stock items and standard commercial articles and services. The revisions in the latter are in tentative form, allowing time for industry comment.

They are scheduled to become effective on Oct. 26.

What's Being Done?

Chairman John Moss (D.-Calif.), chairman of the House Government Information Subcommittee, has called upon Defense Secretary Charles E. Wilson for a report on what is being done by the Pentagon committee studying methods to end security information "leaks" (AW Aug. 20, p. 25).

Moss recommended that the group "be as diligent in suggesting methods to make available non-security information to the public" as it is in protecting classified material. He added:

"We must be conscious of the dangers involved if potential enemies gain access to the nation's military secrets. I believe, however, that under our democratic form of government we must be just as conscious of the danger involved in imposing a blackout on facts about the nation's defense program. Initial hearings with the Defense Department indicated there has been too restrictive an attitude in the information field" (AW July 30, p. 30).

Headed by Charles A. Coolidge, a former assistant secretary to Wilson, the committee includes Adm. William M. Fechteler, USN; Gen. Gerald C. Thomas, Jr., USMC; Gen. John E. Hull, USA, and Lt. Gen. Idwal H. Edwards, USAF.

Joint Certification For H-21

The Civil Aeronautics Administration and Canadian Department of Defense have undertaken joint certification of the Vertol H-21 helicopter, marking the first time the two countries have shared in the investigation of an aircraft. Although Canadian aircraft certification is based upon U.S. standards and each country recognizes the other's approval, the joint certification was decided upon because the H-21 may soon be manufactured in Canada as well as the U.S.

Civil certification of the helicopter was requested since the Canadian government is contemplating the transfer of DEW Line operations by the H-21 from the Royal Canadian Air Force to civil jurisdiction.

Campaign For Scientists

Dan Daniel, American Legion national commander, has pledged a campaign by the Legion's three million members and one million auxiliary members "to interest thousands upon thousands of students in careers in engineering and the sciences." Daniel's pledge came after reports by aviation leaders, on a Legion radio program, on the deteriorating position of the U. S. in the field of trained technical personnel.

On the program, Dr. John V. Victory, executive secretary of the National Advisory Committee for Aeronautics, urged that government pay scales for scientists and engineers be raised to approximate the industry level to allow federal agencies to keep the "brain power" they need to carry out the programs.

ANDB Exceeded Authority?

The Air Navigation Development Board, in a review last week of the draft characteristics of the Vortac common air navigation system (AW Sept. 3, p. 41), exceeded its area of jurisdiction, according to some observers, by drafting minimum performance requirements for the airborne components of the radar beacon. Representatives of civil aviation at the one-day meeting felt that the ANDB should confine its draft to a review of Vortac's capabilities and a description of the ground equipment characteristics. To go beyond these points, observers say, may prevent development of the airborne units. Represented at the meeting were the Air Transport Assn., the Aircraft Owners and Pilots Assn., National Business Aircraft Assn. and equipment manufacturers.

—Washington staff

Mach 5 Speeds Press NACA for Answers

Test techniques also sought for extreme high altitudes; low speed regime remains factor.

Langley AFB—Need for knowledge of aerodynamic, structural and powerplant performance at speeds above Mach 5 and extremely high altitudes is spurring the development by the National Advisory Committee for Aeronautics of new test techniques and analytical approaches.

Aerodynamic heating, dominating the manifold problems of hypersonic flight, accounts for a major portion of NACA's research activity. However, NACA still keeps after the problems at the low speed end of the flight regime that "refuse to be solved."

During its Triennial Inspection of the Langley Aeronautical Laboratory here, NACA showed these specific developments:

- **Four-stage hypersonic** rocket-powered test vehicle that has touched speeds in excess of Mach 10 carrying instrumented payloads to study aerodynamic problems.
- **Two supersonic tunnels,** now deep in intensive test programs for industry, which cover the speed range from Mach 1.5 to 5, and can simulate Mach 2 fighters or Mach 5 missiles at 70,000 ft.
- **Ceramic heat exchanger** to store the tremendous amounts of energy needed to drive a small jet simulating hypersonic flight conditions on tiny models.
- **Flight simulator** that duplicates the vertical motion and pitching of almost any conceivable future airplane with typical characteristics of a long period oscillation and very low damping.
- **Jet-augmented flap system,** usable with pod-mounted engines currently planned for the first generation of American jet transports, and showing takeoff and landing distance reductions approaching 50%.
- **Landing loads** dynamic test facility driven by an impinging jet of water over a concrete runway surface; it can subject an instrumented landing gear to the complex loads encountered in routine or rough landings.
- **New high jet** for simulating Mach 3 flight at high altitudes, with a test section 8¾x6 ft., now under construction and expected to be ready for test programs early in 1957.

Aerodynamic Heating

More than 1,600 engineers and scientists from industry visited this research center during the three days devoted to the presentations.

A titanium nose cone glowed to incandescence, seemed to burst into flames and melted into a blunt-nosed blob. The leading edge of a magnesium missile fin eroded and the missile went violently out of control. These two graphic illustrations, when in color motion pictures by NACA, underscored one problem of aerodynamic heating.

Most of the NACA work on the subject is directed toward providing design data for two basic concepts: the ICBM and the manned, hypersonic glider that could be a long-range bomber system. Each of these weapons will be subjected to vicious heating during flight to the target, and must be designed to hold together for the life of the mission.

There the similarity ends. Heating on the nose cone of the ICBM will be intense for a short time; on the hypersonic glider, it will be less intense, but for a period measured in minutes instead of seconds. Heat inputs to the nose cone will be about 1,000 btu. sq. ft. /sec.; on the glider, the heat input will be only one-twentieth of that on the leading edge and one-two hundredth of that on the wing surface.

NACA studies show that the leading edge heating can be reduced by increasing the angle of wing sweepback; a 60-deg. delta layout would only have about half the heat input of a straight-wing aircraft.

It's a long step from calculations of these temperatures to their simulation in free-flight or model tests; NACA is developing a whole family of test techniques aimed at getting design data from scale and full-sized models of aircraft and missiles.

Loss of the Bell X-2 has been a body blow to the full-scale heating research program; NACA says the program will inevitably be slowed down. The X-1B and X-1E will not be able to fill the gap, but will be able to make substantial contributions to the overall program.

Multi-stage rocket vehicles, flown from the Pilotless Airport Research Station at Wallops Island, Va., have proven most useful tools. One four-stage vehicle uses the Honest John rocket for a first stage, a Nike booster for the second, a T40 artillery rocket for the third and a T55 as the sustainer powerplant in the fourth stage, which is also the instrumented payload. Another four-stage rocket using two Nike boosters for first and second stages reached a speed of Mach 10.4 at an altitude of 84,000 ft., and eventually coasted to a peak altitude of 200 mi.

Among the test vehicles flown has been one with a number of metallic probes projecting outside the calculated boundary layer to check heat resistance of different metallic materials.

New kind of a trajectory, called over-the-top by NACA, has been tried to simulate re-entry of an ICBM. Four-stage vehicles are used in these tests, but only two stages are fired during the ascent to zenith. After the rest of the rocket begins its descent on the downward leg of the flight path, the final two stages are fired, producing the highest speeds at the lower altitudes near the earth's surface. A series of hot jet test units has been developed to simulate hypersonic heating on small scale models. Among them are:

- **Ceramic heat exchanger** which stores air above 4,000F. and blasts a jet of air at that temperature over a tiny model at 3,500 mph. Jet diameter is about three-quarters of an inch; the unit was a pilot model to check the feasibility of the idea. Its success has led NACA to start work on a larger version.
- **Ethylene jet** in which the model is placed in the blast of the exhaust from a combustion chamber burning ethylene in air at high temperature and pressure. A 12-in. diameter jet produces temperatures of 3,600F. and speeds of about 3,000 mph.
- **Rocket jet** which can subject a model to a 5,000 mph. blast of air at 4,100F.

Heat-Structure Research

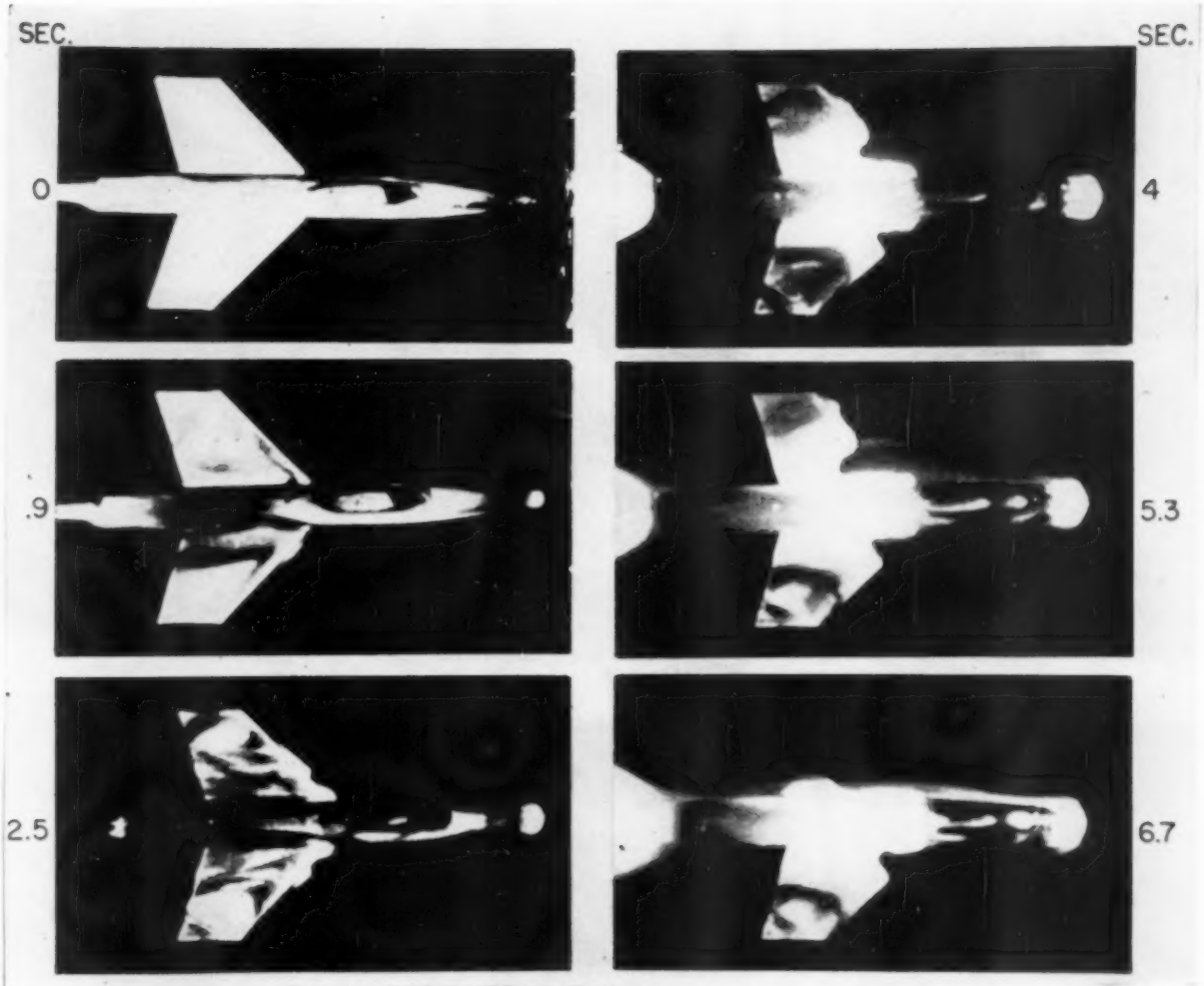
Laboratory investigation of the kind of aerodynamic heating that will affect aircraft and short-range missiles in speeds below Mach 5 is done at Langley with:

- **Equipment** incorporating radiant heat sources, for study of basic structural heating problems.
- **Facilities** in which both actual aerodynamic heating and loading at specific velocities can be simulated.

Radiant sources include the electric carbon-rod radiator which will heat to 4700F. and produce the heating rates up to 100 btu. per sq. ft./sec. that a missile being accelerated rapidly to

Langley Coverage

Continuing its annual coverage of NACA's inspections, Aviation Week publishes this first of several articles on the 1956 Triennial Inspection of the Langley Aeronautical Laboratory. This report was prepared by a three-man editorial team: Asst. Managing Editor (Technical) David Anderton, Military Editor Evert Clark and Engineering Editor Russell Hawkes.



WINGS AND NOSE of stainless steel model in simulated 4,500 mph. 50,000 ft. flight begin to glow (top left). Nose melts, grows blunter; wings melt. Finally fuselage glows, wings disintegrate. Acid ammonia rocket shot hot gasses through 4.5 in. supersonic nozzle for test. Damage was intensified because of small model size-wing span 2.5 in., wing thickness one-eighth inch.

Mach 5 at low altitude would encounter. Advantage is a simple type of heating; disadvantage is that the heating rate cannot be varied rapidly as it would be in flight.

Variable heating is produced by means of quartz-tube heat lamps which can be arranged in banks to surround any piece of test material, and heated and cooled very rapidly. These can be used to study the difference in thermal expansion between an aircraft's skin and its stiffeners or to heat a wing unsymmetrically. In one demonstration, a wing structure was heated at 800F. on its undersurface and 200F. on top, as it would be in the pull-up of a missile. Heat caused a downward deflection of several inches at the wing tip, but the wing resumed its normal shape after cooling. Quartz tube heating can be done at the same time that distributed loads are being applied to test the combined effect on a structure.

To meet the need for a much larger supersonic heating jet than Langley has had, a new supersonic blowdown tunnel is under construction. It will be ready next year.

Test range will be Mach 2-3 and the test section will be 8¼ ft. x 6 ft. air stored at 7,000 psi. will be preheated in a heat accumulator holding 600,000 lb. of stainless steel sheeting and fed by an oil-fired furnace.

STOL, VTOL Research

Turntable in the test section will allow varying the angle of attack which in turn will vary structural loads. Exhaust thrust of the heated air after it passes the test section will be 750,000 lb., the equivalent of almost two million jet horsepower. Duration of the jet will be 15 sec., and the air will be exhausted over a swampy area where there is no habitation.

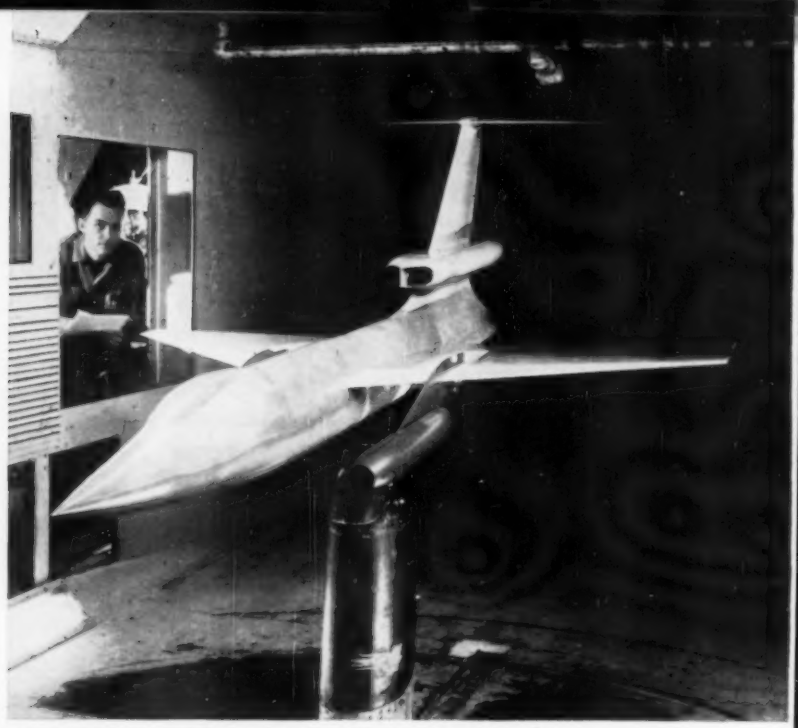
Analytical studies of one jet-augmented flap technique indicate that takeoff distances for large transports can be cut from 8,500 to 4,500 ft., landing distances from 7,000 to 3,700 ft., and landing speeds from 113 to 80 mph.

NACA says the possible gains "are so great as to warrant further serious study."

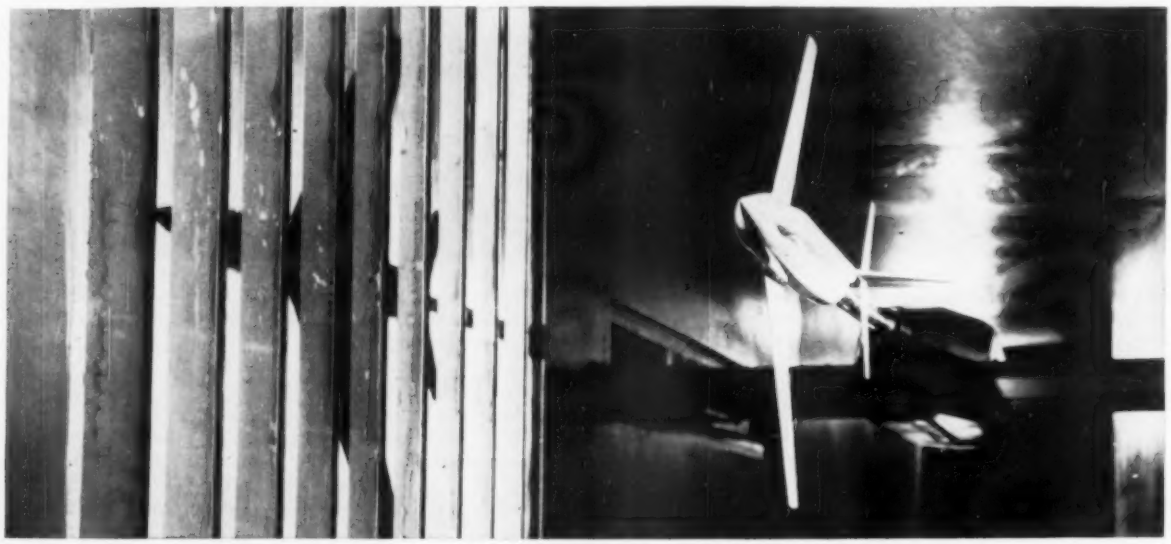
Early studies did not take into account the weight problems raised nor effects on stability and control, but NACA said work in these areas "will be intensified."

The technique is to divert the flow from podded jet engines—such as those planned for transports now past the mock-up stage—upward against a small-chord trailing edge flap.

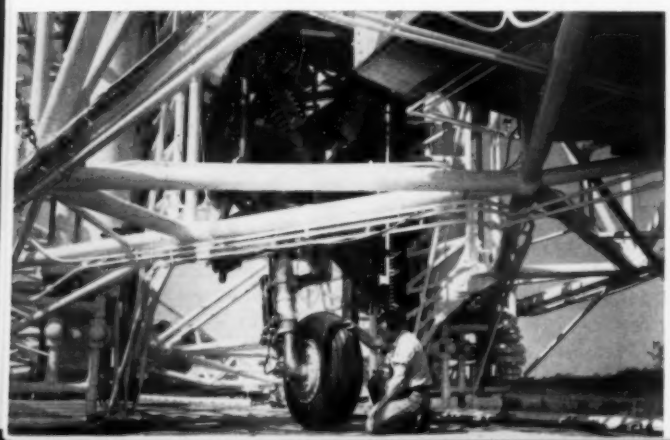
Second technique—which produces slightly smaller gains but increases weight and structural problems even more—calls for use of small high thrust-

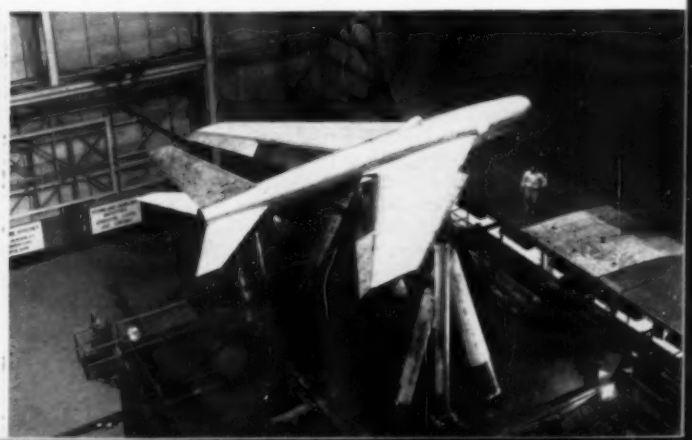


LOCKHEED F-104 (left) tested on unique force-roll sting. Model (right) is used for low-speed stability test of high speed aircraft.



SCALE model of Bell X-2 (above) is mounted in unitary plan supersonic wind tunnel for calibration tests. Landing gear (below, left) is mounted on test carriage at Landing Loads Track. Swept-wing model (right) is used for high lift test devices.





weight ratio engines inside the wing. Exhaust would flow through slots at the trailing edge producing a narrow, full-span flow of air.

NACA also is investigating three types of jet powered vertical takeoff aircraft—"tail sitters" like the Ryan X-13, and horizontal takeoff types in which jet thrust is deflected downward through a cascade of vanes or by rotation of the engine.

Electrically controlled dynamic models, powered by hydrogen peroxide rocket motors ranging in thrust from 6 to 60 lbs., are used in the VTOL experiments.

One new facility for use with the models consists of a standard hoisting crane, statically mounted on a circular concrete apron and sheltered by trees to prevent unwanted wind effects. A model is tethered horizontally and allowed to fly in a circle around the crane mountings. The crane rotates at exactly the same speed as the model, with its boom constantly holding a slack safety wire leading downward to the model.

Top speed of a model tethered to the crane with a 50 ft. wire is 70 mph. At that speed the crane's rotation is 20 rpm. using a 65-ft. wire, the model can be flown at 100 mph.

Langley will soon put into operation still another new VTOL-STOL testing facility—a specially-instrumented truck using a safety suspension boom and carrying "pilots" who can control roll, pitch and yaw electrically.

Unitary Wind Tunnel

Langley's newest unitary plan wind tunnel is capable of simulating conditions that a 40-ft. missile would encounter at Mach 5 and 70,000 ft., or the conditions a fighter aircraft would find at a speed above Mach 2 and the same altitude.

The $15½ million installation has been in operation since August. It includes two sliding block, variable supersonic test cells, with test sections measuring 4x4 ft. One tests in the range from Mach 1.5 to 2.8, the other from Mach 2.3 to Mach 5.

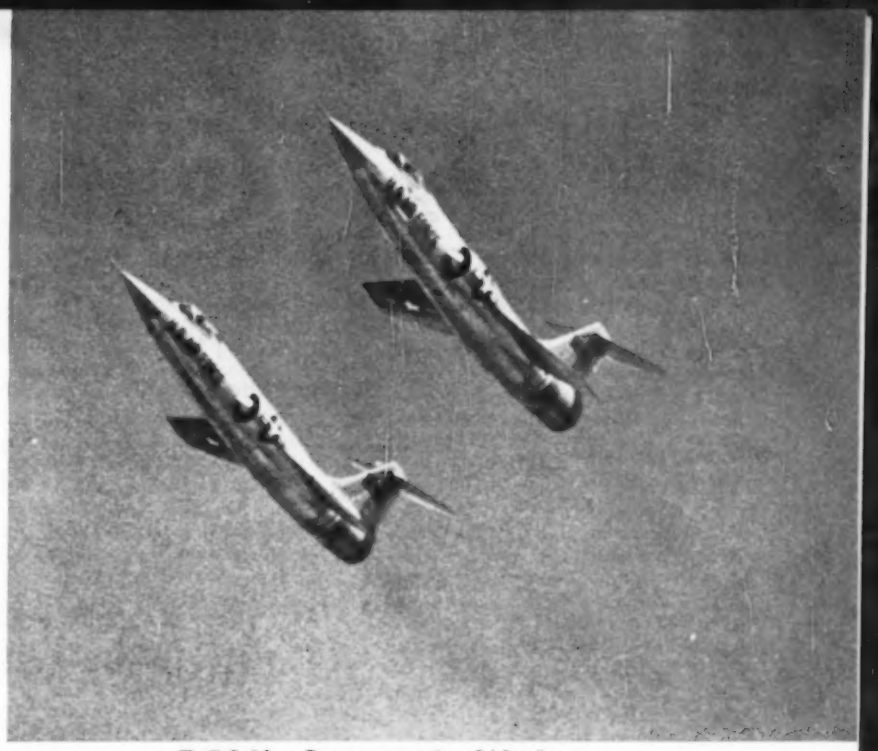
High on the priority list for study with this tunnel is the decrease in directional stability that occurs as speed increases—a major problem in supersonic fighter design.

Conventional lifting surfaces at high speeds may lose effectiveness to the point that positive directional stability becomes unacceptably low. The variable speed tunnel can determine not only at what point the stability of a particular design begins to decrease, but the point at which it becomes too critical to accept.

A 100,000 hp. electric drive serves both sections, so only one can be used at a time—but it is possible by a special valving arrangement to shift the flow of air at will from one section to the other without shutting down the tunnel flow.

Shapes are sting mounted on a movable horizontal strut which allows both vertical and horizontal tilting.

NACA is investigating use of ventral fins, use of wedge type airfoils for tail sections, and changes in tail location in its directional stability studies.



F-104's Supersonic Wedges

Second and eighth production Lockheed F-104As have engine intake wedges. Wedges or ramps are used to create shock wave to get air inside engine at speeds above Mach 1.4 (AW April 23, p. 34). Speed of J79-powered fighter exceeds Mach 1.5.

Piloting Problems

NACA is investigating use of ven-control systems for high speed, high altitude aircraft and manned missiles are keyed to problems created by disappearance of aerodynamic force in rare upper atmosphere, growing distance between top and bottom of the speed scale and changing aerodynamics at high Mach numbers. Problems are that:

• **Low dynamic pressures** in atmosphere above 100,000 ft. require dangerously high angles of attack for even small load factor maneuvers.

• **Best shapes** for high supersonic flight are poor performers in low speed regimes of takeoff and landing.

• **Large inertia** and reduced control effectiveness result from greater strength requirements and complexity and necessity of designing for high speed regime.

• **Stability varies** with Mach number. A configuration with good aerodynamic damping at subsonic speeds develops poor damping on the other side of Mach 1. Period of oscillations decreases to a point lower than period of pilot reflexes. Normal pilot response may even build amplitude of oscillations.

• **Stability in rolling** maneuvers disappears as wings get thinner, shorter and mass is concentrated near fuselage centerline.

• **Aerodynamic controls** at altitudes outside the atmosphere are useless and self-contained power is needed to exert any control force.

Variable geometry wings have been studied as a means of improving control.

Efforts to cope with undamped yaw and pitch at high Mach numbers is based on command control of rate and attitude gyro stability augmentation systems. Ability to hold target in transonic buffeting was much improved by system in studies using F9F-2 test plane. NACA test pilots have reported that more attention can be diverted from control of plane to tactical problems. Small, arm-rest-mounted control stick has been used in tests of command control. Pilots prefer it to big floor-mounted stick.

Instability problems are simulated on ground by a cockpit section mounted in a high speed elevator in the middle of a two-story, half-cylindrical screen. Pilot's task is to center projected crosshair on moving red ball target. Instability simulator feeds multiple rates into elevator motor to complicate his problem. Simulation is limited to ver-

tical plane. Programmer can simulate stability characteristics of current types, manned hypersonic rocket gliders or ballistic vehicles.

Stability problem in space differs from that in atmosphere in that period of oscillations is longer. Aerodynamic correction is impossible. NACA's Langley Aeronautical Laboratory has used "Iron Cross" simulator to try out control by pressure jet reaction. Smooth control is difficult. Command control-stability augmentation system will probably be used.

Dynamic Loads Research

NACA research on fatigue failure due to various recurring loads has ranged from small amplitude, acoustic frequency loads to long term pressurization cycling of cabin structures.

NACA studies indicate that resistance to damage by acoustic loads depends upon the relationship between the weight of the skin and the weight of supporting structure. In comparative studies an aircraft aluminum skin with spot welded stiffeners failed after a few minutes of intense acoustic vibration. A stiffener failed in about an hour. Thin-skinned honeycomb structure survived seven hours of similar treatment before the skin split.

Gust loads upon aircraft structure can be reduced greatly by using techniques explored at Langley. Extension of airflow deflectors below wing can reduce slope of lift curve by 25-30% and eliminate heavier loads. Reduced slope kills part of up-draft. Retraction of deflector increases lift to damp vibration.

By destroying a number of pressurized cylinders, NACA has learned that an increase in amount of ring reinforcing reduced danger of explosive failure of pressurized cabin.

NACA flutter studies show that magnitude of initial disturbance required to start flutter in some cases can be increased and damping can be improved simply by insuring that control hinge mounting is tight.

Aerodynamic heating has been found to be an important factor in susceptability to flutter. Flutter resistance of a control surface holds up well if the surface is uniformly hot or cold. But sharp leading and trailing edges concentrate heat, leaving the center of the surface cold. Resulting stresses cut torsional stiffness and set up self-excited flutter which can destroy the surface in short order. If the surface survives flutter it will damp out as heat spreads to equilibrium.

Landing Load Test

Langley is now using a unique facility called the landing loads track to delve into the complex problem of landing gear spin-up in high speed, heavy load landings. Facility consists of a 50-ton carriage propelled down a 2,200-ft. runway strip at 660 fps. by a blast of water. Water is stored under 3,300 psi. pressure and directed against bucket on carriage for several seconds during firing. The "hydropult" is capable of accelerating the carriage to speeds of 150 mph. within 400 ft. and 3½ sec. the jet produces a thrust of 400,000 lb.

Interference

A 20-ton landing gear drop test rig is housed in the carriage. The carriage is stopped by 20 standard Navy arresting gear pennants, each capable of absorbing four million foot-pounds of energy. A tow tank runs alongside the strip for drop testing of hull specimens.

Interaction of flow fields in supersonic flight produces interference effects that can make or break an airplane design. In one case, a 1,000-lb. external store pylon-mounted under the wing of a supersonic airplane caused a side load of half its weight on the pylon due to interference.

Extensive NACA studies in wind tunnels on the interference problem, drawing on a background of at least two decades of subsonic work, have shown that there are three basic considerations:

- **Interference** is always present.
- **It is not always** detrimental to airplane performance, and may sometimes help overall aerodynamics.

There is no single solution; each design is a separate compromise.

One Orbit Out of Twelve "Good" Satellite Average, Martin Says

By James Dailey

New York—As many as a dozen Vanguard satellites probably will be fired during the 1957-58 International Geophysical Year in an effort to achieve an orbit, although prime contractor Glenn L. Martin Co. has a firm contract for only six.

Malhon Winter, Martin's manufacturing manager for Project Vanguard, described the satellite work in an atmosphere of tolerant skepticism last week before a New York Air Materiel Command Reserve Unit meeting.

"We'll consider it a good batting average if we can get one to orbit out of the dozen," Winter told the air materiel officers.

Winter said that so far the program was on schedule with bugs and bottlenecks being conquered pretty much as they occurred. These include procurement of certain types of components, usually avionic components. One of the toughest jobs has been preparation of the elaborate test facilities at Cape Canaveral, Patrick AFB, Fla., from where the earth satellite will be launched.

He indicated three test firings will be made, or more, if they are necessary. These are expected to start next month. At least two will be modified Viking rockets and the third will be an aerodynamic prototype of the Vanguard itself, although it will not be an orbital vehicle (AW Sept. 24, p. 26).

Winter emphasized that the Vanguard program was one of experiment, and as such was bound to experience some failure. "We're blazing the trail of Gallileo and Columbus," he said. "We're investigating the unknowns of outer atmosphere and space. We're trying to find out about radiation, infrared and radio waves; density, temperatures and composition; space dust and meteoric particles; thickness of the earth's crust, distance between points on the earth, and a hundred other things. It's a big job."

Theoretically, the vehicle is to be launched vertically, tilt gradually along its course until it orbits somewhere between 200 and 400 mi. at a speed of 18,000 mph. The first stage is supposed to cut off at 30 to 40 mi. altitude at 3,500 mph., the second at 130 mi. altitude and 11,000 mph. Then it is supposed to coast to about 300 mi. altitude, where the third stage will fire the satellite on its 18,000 mph., spinning trajectory.

Vanguard will be aimed between 8 and 35 deg. to gain optimum velocity from the earth's rotation. Winter figured this will add about 1,000 mph. to Vanguard's speed.

Information Relayed

Martin has the basic design responsibility. Subcontracts have been awarded to General Electric for the first stage propulsion unit aid to Aerojet General for the second stage. Third stage is under development at Grand Central Rocket Co. and Allegheny Ballistics Laboratory.

As Winter put it, Martin was awarded the prime contract because it had previous experience with its Viking high altitude research rocket. "We didn't have to compete for the job," he said, "it was handed to us."

As the satellite orbits, it will relay information to several dozen Minitrack stations installed along the 75th Meridian. Within 20 min. after the satellite has passed in its orbit, information

will be relayed from the Minitrack installations to a central data computing station in Washington, D. C.

However, radio amateurs (hams) also will be utilized to provide supplemental data. "With about $1,000," Winter said, "anybody can get enough radio components together on a 'do-it-yourself' basis to receive the signals from the satellite."

200-400 Mile Altitude

Winter said Martin engineers hope to attain an elliptoid (out-of-roundness) track for the Vanguard of between 200 and 400 mi. altitude, but they are "allowing themselves as much as 1,000 mi. tolerance."

He estimated a 200 mi. perigee (low point) and 1,200 mi. apogee (high point) would be sufficient.

"The more the satellite dips into the atmosphere, the less will be its life span," Winter said. "If the vehicle starts to orbit below 100 mi., the satellite won't go around for another pass. If it hits as high as 200 mi. the time can be two, three or four weeks. A small variation in angle can make the difference between achieving an orbit or a firecracker."

Nuclear Energy

Winter said that if a good shot is achieved—an orbit of about 300 mi.—there should be a year of orbiting before the satellite starts earthward.

"A lot," he said, "depends upon what it runs into out there—space dust, energy particles, meteorites, etc."

Other points that were brought out by Winter:

- **Nuclear energy** powered satellites could be a possibility within ten years.
- **During IGY,** several other rockets such as the Aerobee Hi and Viking will be fired from various spots around the earth to tie in with the satellite program.

Australian Production Of Sabre-Avons Cut

Melbourne—Production of Sabre-Avon fighters by Commonwealth Aircraft Corp., Melbourne, has been slowed to two planes a month. Previous production was three planes a month and a figure of four to five had been projected.

About 1,000 employes have been dismissed, and it is feared another 1,000 will receive notice soon because of the lack of orders. An effort is being made to keep skilled personnel on the payroll.

Commonwealth, which has delivered 50 of the Sabre-Avons to the Royal Australian Air Force, still hopes to manufacture under license Lockheed F-104 fighters for the RAAF.

Vertol, Northrop Discuss Merger; Berlin May Head Combined Firm

Morton, Pa.—Don R. Berlin, president of Vertol Aircraft Corp., probably will become operational head of a new major aircraft industry combination if current merger negotiations with Northrop Aircraft Inc., are successful.

Berlin announced last week that Vertol's directors have ordered the management to proceed with discussions on the basis of a Northrop offer to exchange two shares of stock for each share of Vertol stock after a 15% dividend payable Oct. 29.

Informed sources say this would give the Laurence S. Rockefeller interests, largest Vertol stockholder, about 16% of the new company. Approximately another 10% would pass to Frank N. Piasecki, founder of Vertol and now president of Piasecki Aircraft Corp.

Both Northrop and Vertol stocks scored price increases as news of a pending merger was discussed last week. The Hawthorne, Calif., firm, developers of the USAF Snark intercontinental missile, saw its shares edge up on the New York Stock Exchange to $24⅜. Before the announcement of merger discussions, the going price was $23¼.

Vertol shares, sold over-the-counter, at one point went into the $50 range. Previously, it had sold for approximately $45. Vertol has 471,485 shares outstanding and Northrop has 1,584,000.

Berlin predicted that "Vertol's growth could be accelerated through combining with a large manufacturer such as Northrop. The activities of both companies, he said, "complement each other."

Vertol, formerly Piasecki Helicopter Corp., is the largest independent manufacturer of helicopters. It received its present name last year when Frank Piasecki was ousted as chairman and a member of the board in a bitter row with Berlin and the Rockefeller management interests. Piasecki, in this case, is known to agree with the majority stockholders that a merger with Northrop would be favorable.

Northrop, manufacturer of the F-89 Scorpion, had sales last year of more than $283 million and expects the figure to hit $300 million this year. The company's backlog is about $229 million.

Vertol's 1955 sales were $57.7 million, and the current backlog is reported to be in the neighborhood of $140 million.

Whitley C. Collins, Northrop president, said he believes a merger of the two firms would be mutually advantageous. Collins and Berlin are known to have conferred with their customers, and it is reported that the combination received warm endorsement in some quarters.

Northrop, according to informed observers, probably stands to gain most from the merger. In addition to a solid interest in its activities by the Rockefeller organization, it will acquire Berlin's wide production experience. Berlin came to Vertol in 1953 from McDonnell Aircraft Corp. and had previously worked for Curtiss-Wright and Douglas Aircraft Co. He is an engineering graduate of Purdue University.

Kaman Flies Turbine Helicopter

Marine Corps Kaman HOK-1 helicopter fitted with Lycoming's XT53 free turbine engine hovers after rollout at factory at Bloomfield, Conn. Kaman said it is the first helicopter to be equipped with the engine and the first U. S. helicopter airborne with a turbine developed specifically for helicopter application. USAF 50-hr. flight approval tests have begun. Wright Air Development Center sponsored and directed XT53 development.

New Agency Controls Air Contracts

By Claude Witze

Washington—Defense Department's new Military Traffic Management Agency began operation this month, assuming responsibility over the award of Fiscal 1958 air carrier contracts for all branches of the armed services.

Headed by Brig. Gen. Edmund C. R. Lasher, the office carries out the Single Manager assignment delegated to the Secretary of the Army by Defense Secretary Charles E. Wilson. In his new position, Gen. Lasher, as executive director of MTMA, will exercise traffic management responsibility over Army, Navy, Air Force and Marine Corps transportation within the U. S.

Gen. Lasher told AVIATION WEEK that he does not anticipate any change in contractual procedures "until we find the need for them" and emphasized that the military services will retain responsibility for so-called movement control functions. These are "requirements for transportation services."

Where Responsibility Lies

The military services, it was reported, will be responsible for deciding what is to move, where it will move and when it must be delivered. MTMA will determine how it is to move.

A strong possibility is that MTMA will meet some resistance, or at least skepticism, from present operators of the USAF Logair and Navy Quick Trans charter air transport systems. In the past few years, Logair, managed by USAF's Air Materiel Command, has grown into a major freight operation, with more than $16 million in contracts to four carriers. Quick Trans also is a contract operation, involving five round trips weekly, coast to coast.

Spokesmen for both Logair and Quick Trans have stressed the importance of internal control over these operations in order to insure maximum utilization of their capability. In the case of Logair there is no question that the combat capability of many USAF wings depends upon the reliability of the air carrier and closely integrated control of what is hauled.

Contract Reshuffling?

Gen. Lasher said that once his central procurement function is under way—beginning with contracts to cover Fiscal 1958—the Military Traffic Management Agency will conduct a continuing and intensive study of all service requirements. The possibility appeared strong that some reshuffling of contracts and routes may result if MTMA decides that it may get better service this way.

It was suggested that, once the contract air carriers see the results of MTMA's studies, they may be able to volunteer more efficient routes and thus help the new agency get more lift for its expenditures.

Another possibility is that MTMA eventually will force greater reliance upon existing commercial air freight and air express services, if it sees economies in such a program. Unless there is some important military reason for maintaining a contract freight route, it is possible the new agency will favor commercial services.

Major carriers now holding contracts with Logair are Resort Airlines, Inc., Washington, D. C.; American Air Export & Import Co., Miami, Fla.; Capitol Airways, Inc., Nashville, Tenn., and Riddle Airlines, Inc., of Miami.

Navy's Quick Trans operation is run

Military Traffic Management Agency Regional and Branch Offices

Eastern Traffic Region:
Headquarters ..... Pittsburgh
Branch Office ..... New York
Jurisdiction: Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont.

Southeastern Traffic Region:
Headquarters ..... Atlanta
Jurisdiction: Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, West Virginia.

Southwestern Traffic Region:
Headquarters ..... Dallas
Jurisdiction: Arkansas, Louisiana, New Mexico, Oklahoma, Texas.

Central Traffic Region:
Headquarters ..... St. Louis
Branch Office ..... Chicago
Jurisdiction: Colorado, Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Montana, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin, Wyoming.

Western Traffic Region:
Headquarters ..... San Francisco
Branch Office ..... Los Angeles
Jurisdiction: Arizona, California, Idaho, Nevada, Oregon, Utah, Washington.

Brig. Gen. E. C. R. Lasher

Brig. Gen. Lasher

Brig. Gen. Edmund C. R. Lasher, executive director of the Military Traffic Management Agency, heads the single office in Washington now empowered to negotiate with air carriers for Defense Department contract transportation within the U. S. A.

Gen. Lasher, 50, was graduated from West Point in 1929 and has been in traffic-control work continuously since the early days of World War II. He has been assistant chief of Transportation for Traffic; commandant of the Transportation School, and executive officer of the staff of Joint Military Transportation Committee, Joint Chiefs of Staff.

under contract by California Eastern Aviation, Inc.

The Army thus far has nothing comparable to Logair and Quick Trans, but the new Modern Army Supply System (MASS) is expected to develop a requirement for substantial use of air transport in its program to cut down on stock piles and in-transit supplies.

With headquarters in Washington, the Military Traffic Management Agency will start out with a field organization of five regional offices; three of these will have branch offices (see box page 32). Total personnel will be about 1,000 with 400 of these at the Washington headquarters. Civilian employes now working for one of the armed forces in traffic and transportation functions will be given an opportunity to qualify for MTMA jobs and transfer to the Army payroll.

According to the Defense Department, MTMA is expected to improve military preparedness, effect economy and reduce duplication of effort. The program carries out Hoover Commission recommendations.

Japanese Test Rocket Prototype for IGY

Akita, Japan—Kappa 128 JS rocket, prototype of a two or three-stage rocket to be used during the Japanese participation in the International Geophysical Year, was fired recently from Tokyo University's rocket proving center at Michikawa Beach.

The experimental supersonic rocket, five inches in diameter and weighing 88 lb., was launched by a team of the university's Technical Research Institute headed by Prof. Hideo Itokawa.

Rocket is capable of developing a maximum speed of 2,700 fps. and traveling 24,000 ft. during its 72-sec. flying time. It uses a solid propellant. Firing angle of the rocket was 60 deg.

Present at the launching were members of the special rocket committee of the Japan Council of Science and the U.S. Embassy air attache. A series of rocket tests will take place this winter to try out a Kappa 128 JT rocket with an automatic radio transmitter and a two-stage rocket with a booster to attain 31 mi. altitude.

North American Gets Titanium Research Award

North American Aviation has received a three-year, $2.2 million USAF contract for research on new titanium alloys suitable for supersonic aircraft and missiles. The company will evaluate the characteristics of three or four alloys and later make comprehensive testings on the one alloy selected.

Fixed-Wing Concepts Block True Helicopter Future, General Says

Dallas—Helicopter development is in a "state of doldrums" because both users and manufacturers have been applying the fixed wing approach to design and operations, Brig. Gen. Carl I. Hutton told the Western Forum of the American Helicopter Society here last week.

"It is a truism that fixed wing ton-mile costs were reduced to manageable proportions by making drastic increases in the size of the aircraft and doubling or tripling their operation speeds," he said. "The attempt to follow in this direction has led to some pretty costly experiments in helicopters.

"These two factors—costs and speed limitations—appear to me to nullify the fixed wing approach for helicopter designs and operations. They cost too much when we make them big, and at the present time we cannot make them much faster."

A helicopter designed with emphasis upon optimum size as regards initial costs, economical operation and low-cost of maintenance would narrow down to the one-ton or ton-and-a-half field, compromising between cost and economy, Gen. Hutton opined.

The manufacturers have been concentrating upon the "somewhat dubious" future of the movement of people, Hutton stated, building heavy fuselages for passenger compartments and making many studies on economics of helicopter feeder lines, taxi services and shuttles, in addition to what Hutton called "comparatively long hauls of 50 mi. and over."

He told the audience of a transportation exercise he had made, without official sanction, reversing completely many of the studies he had seen. He not only ignored accepted parameters but chose an entirely new area so that the parameters would not apply. It applied to movement of supplies in that part of the combat zone forward of Army supply points.

Currently, he said, this cargo transport is handled in a standard infantry division by 2,333 vehicles rated at 2½-ton capacity or less, representing a tremendous effort in every division and using several thousand people in the division concerned with operation and maintenance of surface transport.

Hutton stated that supply transport of a division in combat in its main aspect is the reverse of what a professional transportation man would consider a reasonable and orderly business—forward of the supply point the problem is as much one of distribution as of transport. The system is an upside-down funnel with supplies entering the top in a concentrated flow and diffusing all across the bottom.

Trucks sent back to the supply point are hand-loaded. They return to the division area, are unloaded at a distribution point for sorting. Then supplies are again hand-loaded and taken to the regimental combat team supply point, unloaded, sorted, loaded onto trucks and moved forward to be unloaded at least once more.

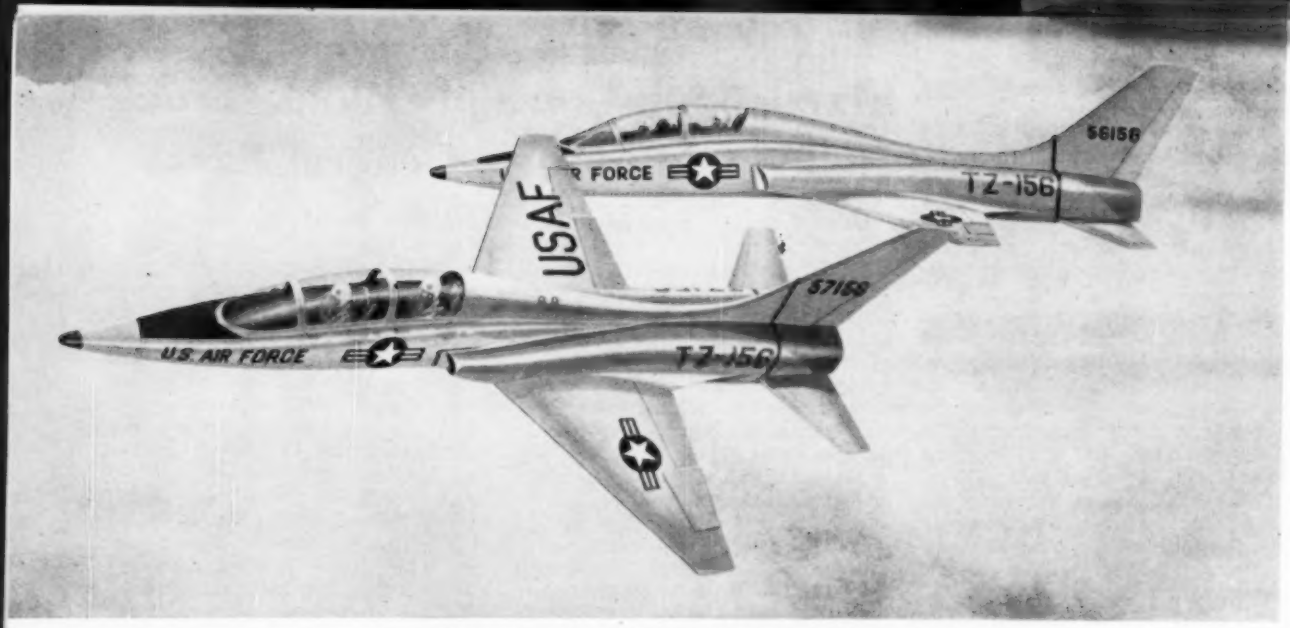
The supplies have been broken down to bulk and weight that can be lifted onto and off the truck by one or two men. This, Hutton, feels is signqificant because it indicates that it makes little difference whether the supplies arrive in one-half ton, one-ton or 2½-ton lots, so long as they arrive when needed.

The characteristics of supply distribution and transport, listed by Hutton: high labor costs because of successive manhandling of cargo; comparatively short cargo hauls, certainly under 50 mi. and probably under 25 mi.; absence of large indivisible loads and widespread distribution points, much of these cross-country across difficult and inacessible terrain. He calls these characteristics tailored for helicopter operations. "We would not need huge helicopters because the distribution of loads does not involve great tonnages at each distribution point and because there are no large indivisible tonnages," he noted.

In connection with the size problem, Hutton mentioned an incident in Korea which he said everyone in the helicopter business should consider seriously. A U.S. infantry battalion on the line had its supplies carried up the mountains on A-frames on the backs of 400 Korean Service Corps laborers. Upon one occasion the laborers were taken away and two Bell H-13s did the work.

The helicopter has the same speed advantage over working trucks as the airliner over passenger trains, he stated, and just as the airliner cannot carry as many passengers on one trip as a train, the helicopter need not attempt to match the ton-capacity of the truck. Its speed differential allows it to do the work of several trucks while carrying smaller individual loads.

He recommended that in the field of cargo carrying, the lead of those commercial operators conducting successful operations should be followed with more attention than has been done in the past, and less attention should be paid to the scheduled operations of the airlines.



Northrop's Supersonic Trainer

Northrop Aircraft Co.'s supersonic trainer design utilizes two small, low-frontal-area turbojet engines mounted in the tail. Drawing shows shallow depths of area-rule fuselage, which has reverse upward belly line curve in area rule region. Horizontal flying tail has about 2 deg. anhedral (AW Oct. 1, p. 29). Rear seat is higher than front. Wing is low aspect ratio of 3-5% thickness.

USAF Needs Direct Ground-Air Radio Communications to 7,500 Mi.

By Philip J. Klass

Utica, N. Y.—A technological breakthrough in ground-air communications techniques is badly needed to give the Air Force reliable, direct radio communications to its aircraft at distances up to 7,500 mi.

This challenge to the avionics industry comes from Lt. Gen. Joseph Smith, commander of the Military Air Transport Service, in a paper given here during the second annual Symposium on Acronautical Communications. Smith's paper was delivered by Col. Forrest W. Donkin, deputy commander of USAF's Airways and Air Communications Service (AACS), who appended some of his own views.

Deficiencies in ground-air communications have so handicapped oceanic air traffic control in the heavily traveled North Atlantic, Donkin said, that "I am amazed that there hasn't been a 'Painted Desert' type accident."

To demonstrate the pressing need for immediate and direct radio contact between Strategic Air Command control centers and SAC bombers, Donkin pointed out that if the international situation became particularly edgy, jet bombers might be deployed aloft in strike position.

"It must be possible to trigger these bombers into action in a matter of seconds, if necessary," Donkin warned.

To prevent unnecessary repeat strikes against the same target, SAC needs to get a fast report on the effectiveness of its initial sortie. If the enemy capitulates, prompt action is needed to call off further strikes. SAC also needs direct global communications to permit it to set up refueling rendezvous on short notice.

Although the present $300 million global USAF communication system is comparable to the best commercial systems, Donkin said, there are too many links in the chain, leading to delays or possible failure.

Coded Communication

SAC is willing to accept a coded transmission for its direct 7,500-mi. communication requirement. Such transmissions might consist of only a few coded numbers and letters which would be sent in a brief high-energy burst, though these transmissions would be infrequent.

However, the system must work without fail in the Auroral belt, Donkin cautioned the symposium.

Research in high frequency peak-pulse, single sideband, UHF extended (beyond-the-horizon) range and meteor-burst techniques show some progress, Donkin said, but added that no one knows for sure whether any of these will meet current USAF needs. "If anyone has a revolutionary approach which warrants development, General Smith would be personally interested in helping to arrange for a sound development contract," Donkin said.

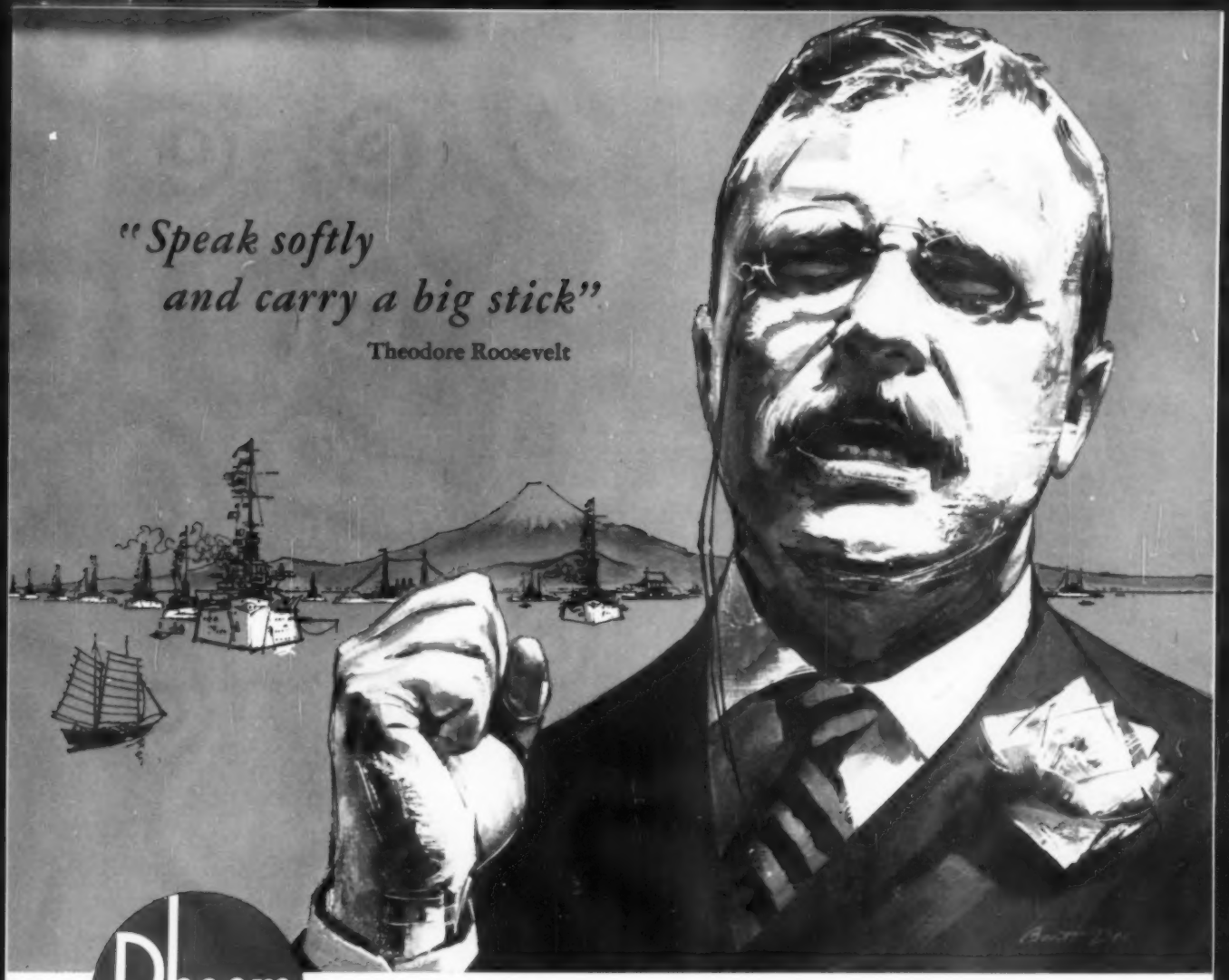
MATS Needs

MATS direct ground-air communications needs for its own operations are not quite as tough as those of SAC. MATS will settle for coded communication at distances up to 3,000 mi., with voice required only up to 1,000 mi. The voice communications can be compressed—bits of speech chopped out—providing the result is still intelligible, Donkin said.

Optimum flight path techniques, as pressure pattern flying, have enabled MATS to achieve a 10% gain in aircraft utilization. However, this technique requires direct ground-air communication with all en route aircraft to obtain accurate pressure and wind data. Such direct communications are not now possible.

Present oceanic traffic control problems stem from a lack of positive ground-air and point-to-point communications coupled with lack of a navigation system suitable for giving an exact position fix. The problem will become more serious as the airlines and MATS switch to turboprops and jets, Donkin warned.

Air Force need for direct long-distance ground-air communications has become so pressing that it can not be satisfied any longer with conventional and small-increment improvements. "The jet age urgently calls for some revolutionary techniques," Donkin concluded.



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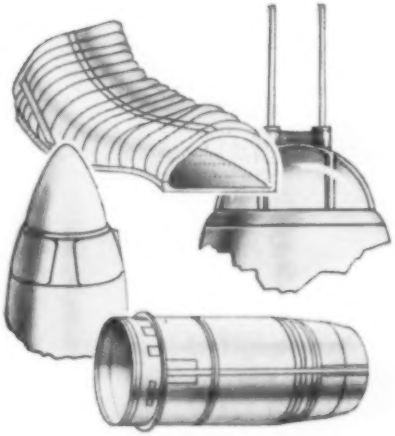

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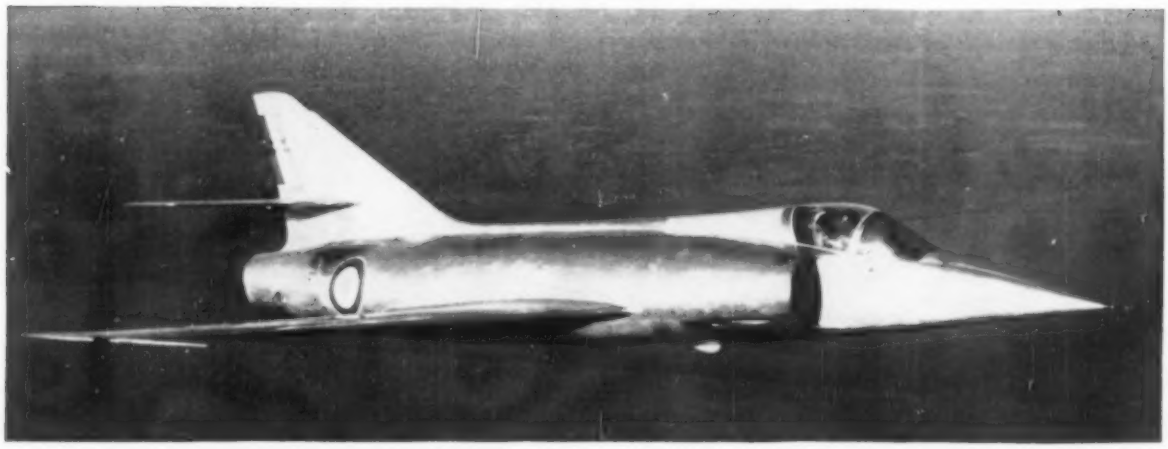


French Etendard IV Light Fighter

Etendard IV, Marcel Dassault's light tactical fighter in first inflight photo (top), is capable of takeoff and landing in 1,800 ft. Powered by Snecma Atar E turbojet engine of 8,000 lb. thrust, it is reported to attain Mach 1 above 25,000 ft. It weighs six tons, lighter by a ton than Dassault's Mystere IV. Etendard IV is a redesignation of the Mystere 24 (AW July 30, p. 25). Use of low pressure tires (50 psi.) enables the Etendard IV to land on grass fields. Tail view (lower left) shows tail chute housing and all flying tail. Taxiing (lower right) with tail chute extended, Etendard IV shows drooped wing leading edge. Intake housing is provided for 20 mm. cannon. The airplane has flown about 30 hr.

News Digest

Beech Aircraft Corp. delivered on schedule last of more than 300 Beech-built T-34A Mentor trainers to USAF. With phase-out of 40-month T-34A program Beech will continue production of T-34B, Navy version, through October 1957.

Hawker Hunter T Mk. 7 two-seat aircraft were ordered by Royal Netherlands Air Force. Order for ten, first from overseas, is expected to be supplemented by another Dutch order for ten.

Lockheed C-130A Hercules completed initial phase of employment and suitability testing by project team from the Air Force Operational Test center, Eglin Air Force Base, Fla. Tests will begin soon of C-130A's ability to land and take off on short, unimproved fields. Fifth production contract, which amounts to more than $100 million, has been awarded to Lockheed Aircraft's Georgia Division for production of C-130.

Air-Fouga is new company formed by five French aviation companies to exploit the Fouga manufacturing works. The companies, Breguet, Dassault, Morane-Saulnier, Sud-Est Aviation and Ouest-Aviation, provided for capitilization of 75 million francs.

Garrett Corp. declared a 5% stock dividend payable Nov. 5 to stockholders of record Oct. 12. Dividend will amount to one share for each 20 shares held. Garrett reported peak sales of $138 million for the fiscal year ended June 30. Net earnings of $4.8 million, compared with $3.7 million for previous year, amounted to net profit of $5.13 a share compared with $4.10 for previous year.

Jet Engines for KB-50

Hayes Aircraft Corp., Birmingham, Ala., will install two auxiliary General Electric J47-23 turbojet engines on a single Boeing KB-50 tanker in hopes of finding some way to save the piston-engined aircraft from an early obsolescence.

Working under an Air Force contract, Hayes will pod one of the 6,000-lb.-thrust engines under each wing. The engines, Hayes says, should give the now-obsolescing probe-and-drogue tanker enough additional speed and altitude to operate with current USAF fighters and fighter bombers.

The company already has been awarded an Air Force contract to convert conventional B-50 bombers into the KB-50 three-point refueling tankers (AW March 5, p. 62).

AMERICAN AIRLINES DC-7 on takeoff. Airline success with this transport has made it more than an interim aircraft.

Jet-Age Role Assigned to Douglas DC-7

Airlines, which bought DC-7 as interim aircraft, say performance, appeal extend life expectancy.

By L. L. Doty

Washington—The DC-7, last of the commercial piston-engine aircraft to be built by Douglas, will continue to play a prominent role in air transportation after the advent of the jet age.

First introduced by American Airlines in November 1953, the DC-7s are no longer looked upon by its operators as simply interim aircraft designed to bridge the gap between 1956 and the year the turboprop and turbojet transports begin to appear in quantity in 1960. After that, the DC-7s will continue useful service on both long and medium-range routes. The reason: relatively-low operational costs.

Jet Age Role

A number of the aircraft's performance characteristics, particularly its speed and range, are giving airlines their first sample of the problems and benefits that will accompany the operation of turbine-powered fleets.

Characteristics that will help insure the DC-7 a long life include:

- **Passenger appeal** has been so widespread that the airplane enjoys a higher load factor than that of most competing models.
- **Maintenance problems** that initially marred its operating records have been solved to give the DC-7 series a high efficiency rating.
- **Operating costs,** which once would have been prohibitive, have been largely offset by good aircraft utilization and high load factors.

The DC-7 already has given airlines their first real experience with the high operating costs that must be accepted if the public's appetite for speed and luxury is to be satisfied. Its operation points up the fact that high load factors and aircraft utilization have become more essential than ever and will be required to an even greater degree in jet-transport operations.

The DC-7, however, is paying its way, and the airlines expect it to retain its passenger appeal even while competing with the more spectacular jet models. A. E. Raymond, Douglas vice president and director of engineering, admits that turbine-powered planes will be more comfortable, obviously faster and perhaps more efficient in many respects. However, he adds:

"These airplanes will not replace the DC-7s. They will be supplementary, and the two types will operate side by side over a period of years."

Sales Volume

Current sales records of the DC-7 best testify to the secure future of the airplane. To date, sales amount to $677,045,649 for 216 DC-7s and DC-7Bs, and 116 DC-7Cs. The airlines thus far have made a larger investment in the DC-7 series than in any previous Douglas model, and the backlog of DC-7 orders stands highest in the company's history.

The dollar value of these sales does not include spares or possible modification of future aircraft. And prices are not likely to creep downward. The DC-7 cost $1,640,050 in 1953. Two years later, the DC-7B had passed the $2 million mark.

The DC-6, priced at $587,000 in 1946, climbed to $874,000 by 1951.

Speed and range are the factors that have attracted the airlines to the DC-7. According to C. R. Speers, American's senior vice president for sales, the airplane offers two major selling benefits —it eliminates unnecessary stops on long-range trips, which the public doesn't like, and enables American to plug speed, which the public does like. The airline bills the DC-7 as the "world's fastest airliner."

High Load Factor

Operators say the relatively high operating costs of the DC-7 are offset by the same factors that create the costs—speed and range. Range, they say, allows an optimum economic operation, since it is axiomatic in airline operations that costs decrease as flight lengths increase.

The high speed, they add, permits the production of seat-miles at a faster rate than any other airplane. As a corollary, its speed, because of its passenger appeal and competitive advantages, produces a higher load factor than other transports. These principles demand high aircraft utilization for their successful application. They undoubtedly will support turboprop and turbojet operations.

United Air Lines reports current direct operating costs of 1.9 cents per available seat-mile for the DC-7 with a 58-seat configuration. This compares with a 1.39 cents cost for DC-6 type equipment. United classifies their DC-7 flights as "Red Carpet Service," and assigns none of these aircraft to coach operation. The airline has 26 DC-7s in service and 30 on order for a total investment of $109 million.

Direct operating expense of the 69-passenger DC-7s operated by Delta

Airlines is also 1.9 cents, with a comparable 1.7 cents cost for the DC-6. During the past year, Delta's DC-7 produced 36% of the company's total available seat-miles, the highest percent of DC-7 service operated by any airline.

Direct flight costs per total hours for domestic operations of the DC-7 by all airlines as of Dec. 31 averaged $408, with United and Delta showing lows of $389 and $387 respectively. Eastern Airlines, using only the DC-7B in the DC-7 class, reported direct flight costs per total hours of $451, with Pan American World Airways' costs amounting to $419 for international operations of the DC-7B.

Cost Comparisons

As comparisons, Northwest Airlines' costs of the Boeing 377 amounted to $442. Average DC-6B cost was $283, the DC-6 averaged $266 and the DC-4 expense was $148. Direct flight costs per total hours in the same period for Capital Airlines' Viscount was $205.

The DC-7s and Eastern's DC-7Bs are currently operated as both first-class and coach flights. But few airlines prophesize the eventual relegation of the DC-7 to a wholly tourist role once it is faced with jet transport competition.

An official of Pan American has suggested that high costs of operation could feasibly divert the turbojets to coach service leaving the longer-range DC-7C to handle a share of the first-class traffic. High density seating, he said, may be required to produce sufficient ton-miles in order to insure a margin of profit at a time when transitional expenses are at a peak.

Tourist/First-Class

This may be the reason behind Pan American's decision to schedule both the DC-7Cs and DC-7Bs as either tourist flights or combination tourist/first-class. The DC-7C tourist configuration is designed with 74 seats. In the Atlantic Division; 12 seats are reserved for first-class passage and 54 seats are allotted to tourist travel. In the Pacific Division, the combination seating arrangement is 22 first-class, 36 tourist.

The DC-7B is designed to hold 72 tourist seats or a combination of 12 first-class and 49 tourist-class. All DC-7Bs are assigned to the Atlantic Division. The airline plans a high density seating of 104 passengers when, and if, its proposed third-class fares are approved by the International Air Traffic Assn. (AW June 4, p. 40).

C. R. Speers believes that air coach traffic will grow more rapidly in the years ahead than first-class business, and American's DC-7 Royal Coachman is designed to capture that market. Thus, the DC-7 is serving a dual purpose for American; it provides the all-around luxury incorporated in the DC-7 which will strengthen the company's participation in the first-class market and yet will lure the ever-growing tourist-class market through speed and nonstop service.

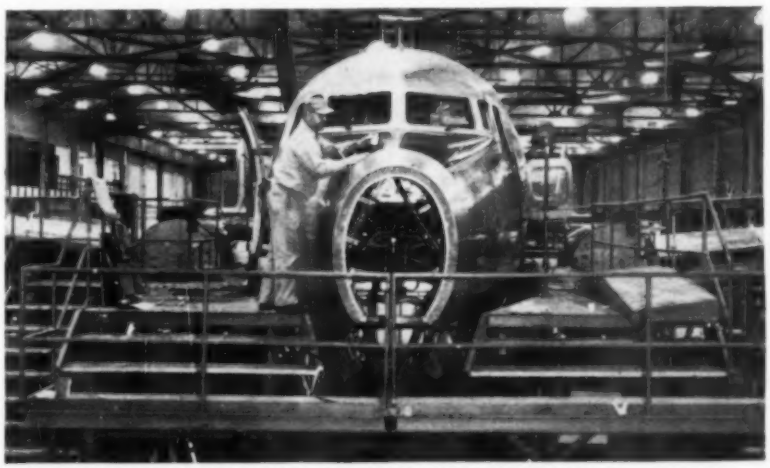
Coach Appeal

Eastern also employs the DC-7B as a means of attracting more first-class trade. Eastern's load factor on its first-class Golden Falcon for the quarter ending June 30, an off-season period for the airline, was 71%. DC-7B coach load factor was 75%. Load factor for Eastern's domestic system for all types of service was 64%.

American's DC-7 coach load factor for the same period was 83%, while the load factor for the regular DC-7 service was 73%. The pattern is generally the same throughout the industry. National, for example, reported a 74% load factor for DC-7 regular service, 81% for coach and 71% for all service at the end of the June quarter. National's coach traffic on all equipment amounts to 60% of all its passenger business.

American's introduction of the Lockheed Electra is not expected to cause any adjustment in projected DC-7 schedules. The Electra is earmarked for short and medium-range operations and, once in full operation, will replace the Convair 240s.

Eastern, on the other hand, will add a fleet of 20 Convair 440s to its system when deliveries begin shortly after the first of the year. The Martin 404s will be moved gradually into the Colonial



AMERICAN AIRLINES DC-7 in bay at Overhaul & Supply Depot, Tulsa.

DC-7 WASH-DOWN at Tulsa. Plans call for side-by-side utilization with jets.

Division to replace DC-3s and DC-4s.

Eastern estimates that its overall $170 million re-equipment program will increase available seat-miles from the six billion annually for 1955 to 10 billion in 1958, when all 60 DC-7Bs on order will have been delivered. A total of 20 DC-7Bs is scheduled for operation this month, and an additional 10 Super Constellations will be added to the fleet between now and Dec. 12.

DC-7Cs for Domestic Runs

Braniff Airways will be the first to operate the DC-7C domestically when service begins Oct. 20. The airline held off purchasing either the DC-7 or DC-7B because it did not consider the aircraft adequate replacements for the modified DC-6 fleet.

Because of its economics on long-range routes and its ability to serve all airports on the Braniff system, the DC-7C is categorized by the airline as a "backbone workhorse" that will provide yeoman service well into the jet age and still bolster Braniff's competitive position in the luxury market for the next three years.

A total of 25 DC-7Cs have been ordered by Pan American. As of Sept. 14, 14 had been delivered, with six assigned to the Atlantic Division, seven to the Pacific Division and one in modification. The range of the airplane was increased over that of the DC-7B by enlarging the wing area and moving engines five ft. further from the fuselage to increase fuel capacity from 6,400 gal. to 7,860 gal.

Braniff, which has ordered seven DC-7s, has designed its fleet to accommodate 45 coach and 28 first-class passengers. The airline plans to inaugurate Latin American DC-7C service early in 1957.

Utilization Average

The DC-7s have proved themselves utilization-wise. It is surpassed only by the Constellation 1049 coach service which shows 12.26 revenue hours per day per aircraft. On regular service, average utilization of the DC-7 for the industry is 9.36 hours in regular service, 9.50 hours in coach service. The DC-7B averages 10.59 hours for regular service, 10 hours for coach. By contrast, the DC-6B utilization is 8.44 hours. The Constellation 749 is running 8.30 hours, the Viscount, 7.12 hours.

Maintenance problems of the DC-7 series have steadily decreased since the airplane was first introduced. However, the aircraft has only recently attained the level of reliability operators expect of it.

William Littlewood, American's vice president of equipment research, who has been as close to the airline's equipment program as any company official, has turned his attention to newer equipment, satisfied that the DC-7 is now performing satisfactorily.

Early Maintenance Problems

Early-day problems with turbine failures, penetration of the flight hood by shedding turbine blades and nozzle box cracks which plagued initial operations are all but eliminated.

Overhaul period for the Curtiss-Wright R-3350 turbo-compound engines is generally between 1,000 and 1,200 hours. United Air Lines has set the DC-7 airframe overhaul period at 2,200 hours. Delta, using the block system of maintenance on airframes, has set 12,000 hours as the maximum time limit for any part.

Unscheduled removals of turbines by United once ran six per 1,000 engine hours, or roughly the equivalent of one replacement to every two-and-one-half coast-to-coast round-trips. By modifying the turbines, the unscheduled removal rate has dropped as low as .2 per 1,000 engine hours, and an even further improvement is forecast by the airline.

Mechanical Delays

Delta's DC-7s are currently flying an average of 85 to 95 hours per mechanical delay, with engines accounting for 45-55% of the delays. The airline now operates a fleet of 11 DC-7s representing an investment of approximately $23 million which includes spares. The first of an additional 10 on order will be delivered in June 1957, and the airline expects to receive about one per month thereafter.

Delta advertises the DC-7 as the Golden Crown fleet and promotes its mechanical ground-cooling system, speed and interior. National's fleet of four DC-7s are used as "lead equipment" in its more important markets. The airline has four DC-7Bs on order which will be delivered in the summer of 1957.

Airlines, in addition to Braniff, not operating DC-7s currently but which have the airplanes on order, are Continental Air Lines with five DC-7Bs to be delivered in 1957, and Northwest Airlines with 14 DC-7Cs scheduled for delivery in 1957 and 1958.

American Selects Electra Interior

American Airlines has designed a radical new interior for its Lockheed Electras which marks a departure from conventional seating arrangements for U.S. airlines.

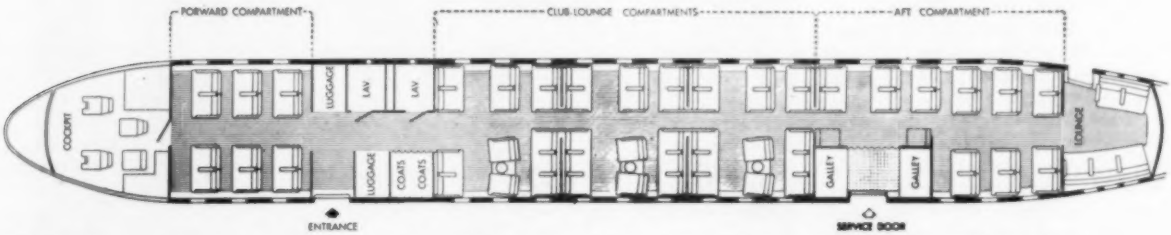
The new design divides the Electra's interior into seven compartments and makes use of fixed seating to give the interior an informal atmosphere and, at the same time, to increase seating capacity.

American's decision to use this configuration is a major departure from the usual airline approach to passenger seating. The extensive use of fixed seating (there will be relatively few reclining seats) appears to be based on American's intention to use the airplane in short-haul markets where passengers won't be on a flight long enough to require a reclining seat.

The new arrangement also will allow passengers traveling in groups to sit together in a separate section.

The design centers around a series of three compartments, each containing 14 seats. The seats are fixed, and two of them are separated by a table and lamp. Overhead racks have been moved to the rear of the compartments, and lights, air outlets and signal buttons have been set into the cabin walls.

Along with the three informal compartments, are two sections with the



ELECTRA interior designed for American Airlines features informal seating groups "living room" style, increased capacity.

Lockheed 1649A Makes First Flight

Lockheed's sixth version of the Super Constellation, the 1649A, made its first flight last week at Burbank, Calif. The airplane, here being tested for weights and balances, was flown 50 min. The 1649A has a wing span of 150 ft., 27 ft. longer and 200 sq. ft. larger than previous models, and engines mounted farther from fuselage, propeller size increased to 16 ft. Six months of flight tests are ahead.

usual two-abreast reclining seats. A section of club-type sets, seating six, will be next to the buffet area, and there will be a lounge in the tail section that will seat five. This gives the Electra a 76-passenger capacity.

American plans to put its Electras into service in early 1959. The new seating plan will mean a three-month delay in original delivery dates, and Eastern Air Lines will now get the first Electra.

Certification Proposed For NWA Tokyo Route

Washington—Permanent certification of Northwest Airlines' temporary Seattle-Tokyo route authority has been recommended by Civil Aeronautics Board Examiner Edward T. Stodola.

Stodola also advised the CAB to make its decision on Northwest's route concurrently with decisions on Pan American World Airways' transpacific applications so that the competitive pattern in the Pacific can be reviewed on an overall, long-term basis.

Favoring permanency for Northwest's Portland - Seattle - Anchorage-Tokyo route, the examiner said the airline has done a good job of developing the route and that operating results have shown recent improvement.

Observing that President Eisenhower decided against making Northwest's route permanent in 1955 because the carrier still required subsidy aid, the examiner said that Northwest has been off subsidy since Jan. 1, 1955, and now meets the President's conditions for permanency.

Stodola also noted that government policy favors competition between two strong airlines across the Pacific and said that permanent certification would help Northwest maintain its competitive position in the growing transpacific market.

Northwest's latest bid for permanent certification was launched last spring after the President asked for fresh advice from the Board on the question of Pan American's pending application to operate over Northwest's Great Circle routing to Tokyo. While considering the Pan American application, the CAB started a parallel case for Northwest's route.

Pan American asked the Board to consider its application for permanency of its Central Pacific route to Tokyo along with the Northwest Case.

The airline argued that the Ashbacker doctrine required the CAB to consider both applications at the same time because they are mutually exclusive.

Examiner Stodola said the Board was right in excluding the Pan American application under the Ashbacker doctrine. He found that granting of the Northwest application doesn't actually foreclose the granting of Pan American's application either now or later.

Since the decision made in the Northwest case will effect long-range American policy on air routes to Tokyo, Stodola recommended that the Board consider its decision in that case at the same time that it reviews Pan American's application for the Great Circle route in another case so that continued service to Tokyo by two U.S. carriers can be assured in the future.

Family-Fare Pattern Extended by Airlines

Washington—A new pattern of family-fare schedules will go into effect this week with half the domestic airlines moving their weekly schedules back by 12 hr.

During the past year, the carriers have been shifting from the usual Tuesday-Wednesday-Thursday schedule for family fares, and now 11 of them are making the family fare effective from noon Monday to noon Thursday.

Using the new schedule are American Airlines, Allegheny Airlines, Bonanza Air Lines, Capital Airlines, Continental Air Lines, Mohawk Airlines, North Central Airlines, Southwest Airways, Trans World Airlines, United Air Lines and Western Air Lines.

Retaining the Tuesday-Thursday schedule are Braniff Airways, Central Airlines, Canadian Pacific Air Lines, Delta Air Lines, Eastern Air Lines, Frontier Airlines, Lake Central Airlines, National Airlines, Northeast Airlines, Ozark Air Lines, Piedmont Airlines, Southern Airways, Trans Canada Air Lines, Trans-Texas Airways and West Coast Airlines.

Last month, Northwest Airlines attempted to expand its family fare plan to cover every day of the week, and Capital proposed to make the plan effective on Saturday as well as the mid-week period. Both proposals were suspended by CAB for investigation.

Faulty Switches Blamed In Viscount Crash

Washington—Faulty propeller control switches were blamed by the Civil Aeronautics Board for the February crash of a Capital Airlines Viscount at Chicago.

The Viscount crashed while landing at Midway Airport. None of the passengers or crew were seriously injured, but the aircraft suffered major damage.

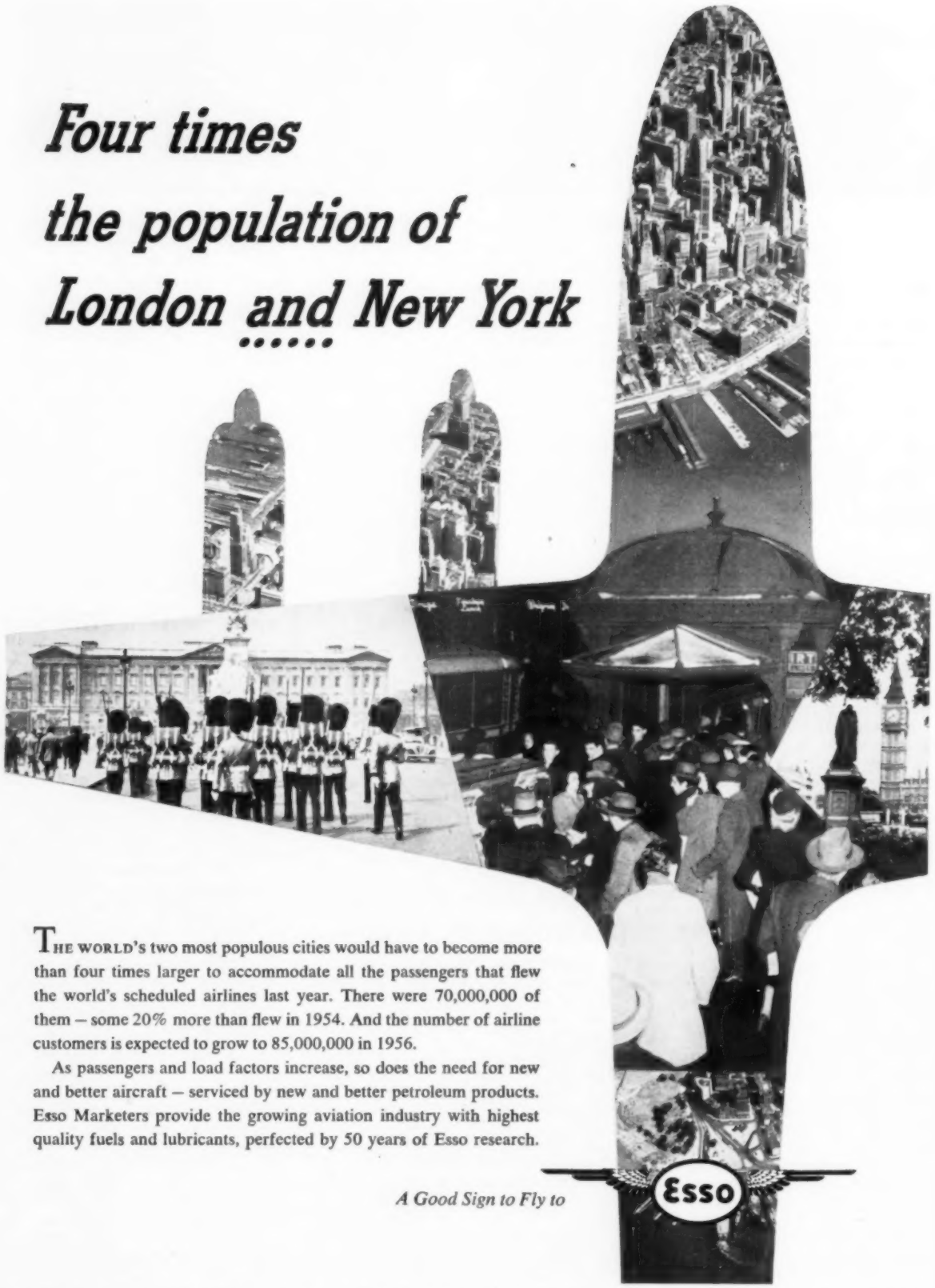
The accident occurred during final approach when the aircraft was over the airport boundary. When it was 25 to 30 ft. from the ground, the Viscount descended suddenly and hit the ground 400 ft. short of the runway threshold. As it traveled down the runway, the aircraft's landing gear retracted, and it then skidded 1,626 ft.

The CAB found that the failure of at least two landing gear-actuated switches allowed propeller pitch stops to be withdrawn, thus allowing the propellers to move below 21 degrees pitch and into the fine pitch range.

When the copilot saw the 17 degree pitch warning lights come on, he advanced all throttles quickly. This action caused the propeller governor control to move the propeller blades to four degree pitch, creating both propeller drag and loss of wing lift.

Capital has established inspection procedures and modified its cockpit warning system to prevent further trouble. Hermetically sealed switches are on order to replace present switches.

Four times the population of London and New York



THE WORLD'S two most populous cities would have to become more than four times larger to accommodate all the passengers that flew the world's scheduled airlines last year. There were 70,000,000 of them – some 20% more than flew in 1954. And the number of airline customers is expected to grow to 85,000,000 in 1956.

As passengers and load factors increase, so does the need for new and better aircraft – serviced by new and better petroleum products. Esso Marketers provide the growing aviation industry with highest quality fuels and lubricants, perfected by 50 years of Esso research.

A Good Sign to Fly to

ESSO

8 OUT OF 10 OF ALL THE WORLD'S INTERNATIONAL AIRLINES USE ESSO AVIATION PRODUCTS

Employment Agency Specializes In Jobs for Pilots, Mechanics

By Glenn Garrison

Teterboro, N. J.—An airline pilot and educational psychologist, running an unusual employment service here and on the West Coast, have registered 18,000 applicants for variety of jobs in aviation. Pilots Employment Agency, headquartered at Teterboro Airport and at Burbank, is now in its tenth year of placing executive and airline pilots, supervisor mechanics, flight engineers, fliers seeking desk jobs in the industry, and an occasional radio operator or stewardess.

Place 1,500

Edward Binder, a Pan American pilot and the eastern half of the partnership, says about 1,500 airline people have been placed through PEA. The scheduled carriers account for about 20% of the agency's business, according to Binder, with another 5% coming through the supplemental carriers. PEA has handled 20% of the airline pilots placed this year, Binder says.

A recent major airline "reiteration" of a policy against discrimination in hiring pilots is good news to PEA, Binder says. The agency has never practiced discrimination, according to Binder, and has registered Negroes as applicants for airline piloting jobs. The agency has never been able actually to place a Negro pilot with an airline, but welcomes the opportunity to do so now.

The agency recently made news by recruiting women pilots for a non-scheduled airline. As it turned out, two women are flying for the supplemental and three more are in the process of being hired.

The western PEA partner is Norman Berdan, a doctor of education and former Navy pilot. The present ownership took over in 1950 from the agency's founder, another Pan American pilot who ran the business from his home in New Jersey. Berdan plans the psychological testing given applicants and the follow up system whereby data is being built up on how the PEA-placed workers get along in their jobs. The agency believes this plan ultimately will provide valuable material for the general field of aviation psychology. Immediately, it helps PEA to work out the tests best suited to determine an applicant's fitness for a specific job.

Executive flying is the agency's biggest field, and Binder claims PEA is now placing the people who man 80% of the nation's business fleet. This includes not only pilots and copilots, but administrative personnel who direct aircraft operations for corporations who use the planes. This year, according to Binder, more than 1,000 applicants, including retired airline captains, will be placed in this executive type of job.

There is some tendency, Binder says, for airline pilots—particularly senior copilots—to move from air carrier flying to the administrative type job which may offer more opportunity.

But the agency works closely with airlines who need additional Civil Aeronautics Administration rated personnel. PEA studies airline route structures, traffic levels, equipment and likes to anticipate the carriers' needs. Binder says it isn't uncommon for an airline to call PEA and announce a need for several hundred co-pilots, for example. The agency's IBM equipment then goes to work looking through the personnel cards.

PEA also keeps up-to-date airline pilot seniority lists as another means of monitoring the airline situation.

French Recruiting

Among the less run-of-the-mill jobs PEA has handled was the well-publicized placement of pilots to serve with the French during the 1953 fighting in Indo-China.

The deal, handled by PEA for the State Department, was secret for many

Manh .ttan Heliport in Business

New York Airways Sikorsky S-55 is handled in routine operation at Manhattan's first commercial heliport, dedicated recently. The helicopters now haul cargo and mail, will begin passenger operation next month. Passenger and operations building is at left.

Over a million airline hours of turbo-prop Viscount experience will be built into the Viscount 810·840

the new 400 mph turbo-prop

VISCOUNT 810·840

higher cruising speed...
up to 400 miles an hour.

bigger capacity...
up to 70 passengers.

greater economy...
with the new Rolls-Royce Dart R. Da. 7 or R. Da. 8 turbo-prop engines.

world wide experience...
gained from over a million hours of Viscount operations.

passenger preference...
as proved by the sensational traffic records of the Viscount 700.

These advantages make the Viscount 810·840 the ideal aircraft for medium-haul, high density routes. It will surpass even the Viscount 700 series as a money maker for progressive airlines all over the world. The new Vickers Viscount 810·840 will make its debut in service for Continental Airlines in 1958.

Behind the new Viscount 810·840 stands the great name of the Vickers Group—internationally famous as makers of aircraft, ships, industrial machinery and precision equipment.

U. S. Representative: Christopher Clarkson, 10 Rockefeller Plaza, New York 20, N. Y.

***turbo-prop* VICKERS**

VISCOUNT

POWERED BY FOUR ROLLS-ROYCE DART ENGINES

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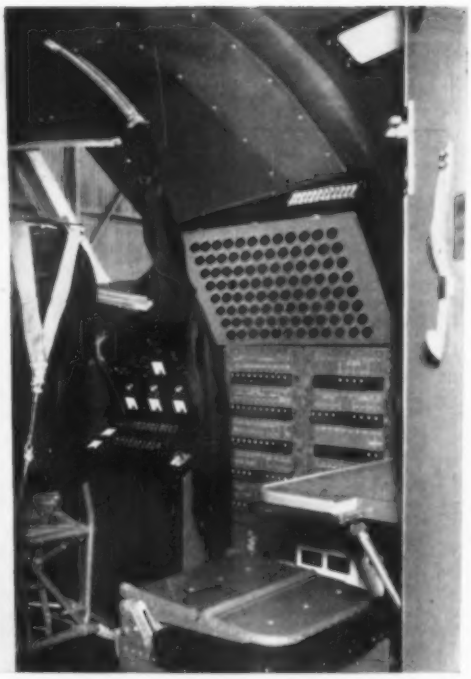


BEA Interior for Viscount 802

Interior layout for British European Airway's new Viscount 802 is generally similar to 700 series. Roofline has been heightened, but three and two seating was used in earlier model. Cabin arrangement looking forward (right), was used for display and demonstration flights at Farnborough, is not necessarily final one. BEA is considering an arrangement to seat 60. Corner of galley (above, left) and radio operator's station (above, right) are shown. Seats are designed by Short Brothers and Harland.

months until the story broke and reporters and cameramen descended on the airport.

The agency also has placed test pilots with such manufacturers as Bell and Martin, helicopter pilots, engineers with aviation backgrounds, jobs, even a fixed base operator for an airport. A current project is supplying pilots and supervisory flight personnel to the civilian contractor (Southern Airways) for the Army's first civilian-operated helicopter school. Another assignment is finding ferry pilots to take B-26 bombers from California to France and bring back Convair 240s which have been replaced by 440 Metropolitans.

All in all, Binder says, the agency now has more than 1,000 aviation jobs waiting for people to fill them. With the current airline pinch for flight crews, he foresees continued growth for his agency.

Shortlines

► **Airlines Clearing House** handled interline transactions worth $57,359,027 during August for a 14% increase over August 1955.

► **Capital Airlines** is supplying blocks of tickets on a monthly basis to qualified commercial accounts under its Commercial Accounts Block Ticket Plan. The companies do their own ticketing and report monthly use.

► **Cubana's** Havana-Miami Viscount flights operated with a 75% load factor during the first three months of service. Load factor on the route reached 87% in August, and sales increased 119% during the three month period.

► **Eastern Air Lines** is entertaining sales personnel from Trans World Air-

Airline Traffic—August 1956

	Revenue Passengers	Revenue Passenger Miles (000)	Load Factor	U. S. Mail	Express	Freight	Total Revenue Ton-Miles	Per Cent Revenue to Available Ton-Miles
DOMESTIC TRUNK								
American	696,138	457,696	69.95	1,617,189	975,327	6,773,005	58,813,411	60.89
Braniff	147,947	60,981	60.93	224,944	134,336	371,139	6,574,884	54.07
Capital	284,967	97,273	58.52	284,717	219,848	319,631	10,136,871	44.87
Continental	63,956	24,257	57.86	75,091	28,818	105,522	2,537,395	48.71
Delta	199,659	94,742	57.89	310,435	284,848	600,312	10,311,823	53.67
Eastern	635,811	311,581	61.36	950,628	484,496	1,373,238	34,351,410	46.48
National	83,001	54,363	60.90	194,746	38,145	300,087	6,064,582	59.37
Northeast	83,513	16,554	64.66	11,322	20,938	34,892	1,568,962	60.02
Northwest	126,854	90,923	68.16	392,992	263,000	676,329	10,243,003	57.96
Trans World	377,427	322,830	71.69	1,009,626	817,460	2,054,664	34,791,215	64.49
United	589,469	423,475	71.75	2,110,996	1,195,359	5,008,631	49,049,318	62.65
Western	108,555	55,977	65.61	225,681	92,146	171,119	5,844,055	57.49
INTERNATIONAL								
American	13,131	9,621	69.39	12,255	797	306,542	1,299,206	67.50
Braniff	2,991	6,224	53.51	19,911	.....	59,657	781,803	56.33
Caribbean Atlantic	16,816	1,148	64.57	1,122	.....	8,066	112,498	62.13
Delta	5,495	6,359	69.44	6,979	.....	28,530	688,462	53.99
Eastern	26,641	35,679	66.86	56,962	.....	81,061	3,953,714	58.56
National	6,496	3,067	49.20	5,378	3,651	20,999	341,557	45.20
Northwest	12,272	26,842	72.54	855,538	24,603	861,550	4,605,902	76.58
Pan American								
Alaska	9,486	10,429	71.56	46,700	.....	404,211	1,531,532	62.26
Atlantic	112,786	146,944	66.63	979,145	.....	1,910,606	18,166,476	62.52
Pacific	31,385	91,389	81.60	1,017,611	.....	1,347,656	11,738,638	75.55
Latin America	119,660	112,982	69.44	348,637	.....	3,058,858	13,863,992	63.58
Panagra	12,487	14,747	61.05	55,228	.....	316,494	1,937,727	59.26
Trans World	30,470	80,326	65.30	746,224	.....	799,239	9,876,037	70.08
United	12,065	29,985	84.40	91,945	.....	59,158	3,211,918	77.34
LOCAL SERVICE								
Allegheny	40,597	6,701	42.96	7,324	19,490	10,178	676,329	44.08
Bonanza	11,451	2,530	44.28	3,713	1,990	8,253	255,724	42.98
Central	8,897	1,734	34.04	3,784	2,247	7,353	178,986	30.74
Frontier	18,581	4,871	51.98	17,172	8,236	63,240	554,327	57.90
Lake Central	13,319	1,999	44.94	2,431	14,031	.....	197,234	33.80
Mohawk	33,942	5,850	55.20	5,798	10,270	11,283	585,327	55.20
North Central	56,667	9,163	55.99	20,445	34,340	.....	932,063	49.85
Ozark	30,305	4,678	37.97	11,158	20,362	11,110	480,192	39.54
Piedmont	40,739	7,793	57.94	15,617	13,826	13,463	788,906	57.55
Southern	17,719	3,094	45.54	9,202	16,389	.....	321,675	43.70
Southwest*	.....	.....	.....	.....	.....	.....	.....	.....
Trans Texas	20,589	4,662	40.05	13,905	8,568	23,305	490,532	36.87
West Coast	22,600	3,911	50.59	3,858	2,531	5,625	365,099	50.30
HAWAIIAN								
Hawaiian*	.....	.....	.....	.....	.....	.....	.....	.....
Trans Pacific	29,445	3,727	59.79	989	.....	20,634	296,112	57.09
CARGO LINES								
Aerovias Sud Americana	.....	.....	.....	.....	.....	663,108	663,108	72.81
Flying Tiger	6,046	23,465	99.56	38,557	35,419	5,567,085	7,987,598	81.28
Riddle	.....	.....	.....	48,230	159,562	3,476,363	1,874,143	.....
Slick*	.....	.....	.....	.....	.....	.....	.....	.....
Seaboard & Western	8,052	34,660	.....	.....	.....	1,809,140	5,275,239	90.04
HELICOPTER								
New York Airways	4,300	81	60.90	954	1,445	615	10,503	64.38
Los Angeles Airways	2,355	86	44.56	3,478	1,874	.....	13,175	49.65
Chicago Helicopter	.....	.....	.....	2,814	.....	.....	2,814	43.51
ALASKAN								
Alaska Airlines	8,037	2,719	38.16	49,085	.....	562,998	979,898	55.09
Alaska Coast*	.....	.....	.....	.....	.....	.....	.....	.....
Cordova	2,336	417	62.33	5,021	.....	347,787	395,249	51.00
Ellis Air Lines	7,916	386	53.02	2,210	.....	3,398	44,589	61.68
Northern Consolidated	3,224	1,111	57.68	25,900	258	323,032	470,978	82.07
Pacific Northern	16,192	13,305	65.79	80,181	.....	378,462	1,892,236	69.22
Reeve Aleutian	1,300	695	73.62	15,998	.....	46,953	137,689	76.10
Wien Alaska	5,466	2,315	20.13	38,539	.....	1,199,567	1,474,888	94.16

*Not available.

Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.

lines, KLM Royal Dutch Airlines, Swissair and Lufthansa this month to inaugurate its "Sell America" program. The program is designed to educate the overseas salesmen on U.S. vacation and business travel areas. The group will tour New York, Washington, Miami and New Orleans while it is in this country.

► **American Air Export and Import Co.** has bought stock in Air Cargo, Inc. AAXICO will use Air Cargo, Inc. for pickup and delivery service when the cargo airline begins service on its New York-New Orleans and New Orleans-Chicago-Detroit routes on Nov. 15.

► **Braniff Airways** adds Chattanooga to its flight schedules this month with the inauguration of a daily DC-6 flight between Dallas and New York via Memphis, Chattanooga and Washington.

► **Flying Tiger Line** added a third DC-6A transcontinental flight to its schedule on Oct. 1. The new flight operates daily between Cleveland and Los Angeles via Detroit and Chicago.

► **Lake Central Airlines** plans to begin service over its recently awarded Youngstown-Erie route on Jan. 1.

► **North Central Airlines** flew 54,210 passengers in September, an increase of 19% over September of 1955. North Central carried 418,694 passengers during the first nine months of the year as compared with 430,445 for the same period of 1955.

► **Northwest Airlines** is using one of its original Ford Tri-Motors to celebrate the airline's 30th anniversary. The Tri-Motor is flying from New York to Seattle during October, stopping at cities served by Northwest on its transcontinental route. The carrier borrowed the old transport from Johnson Flying Service, the present owner.

► **San Francisco International Airport** handled 347,717 passengers in August, a 12% gain over the same month last year. Air freight traffic increased 33.7% to 980,348 lb.; air express rose 20.4% to 7,223,750 lb., and mail traffic was up 12.6% to 2,937,946 lb.

► **Swissair** has opened a sales office in Atlanta to serve Georgia, North and South Carolina, Mississippi, Tennessee, Alabama and Florida.

► **United Air Lines** flew 426,502,000 passenger-miles and 5,082,000 freight ton-miles last month—increases of 11% and 23% respectively over traffic in September 1955.

AIRLINE OBSERVER

► Sud-Est is considering the Pratt & Whitney J75 for its Mark II Caravelle airliner as well as the Rolls-Royce Conway (AW Jan. 23, p. 103). Earlier choice of the Rolls-Royce Avon for the Mark I Caravelle over the Pratt & Whitney J57 was based primarily on the lower weight of the Avon. However, Stud-Est has been seriously hampered in evaluating P&W engines by U.S. security which makes it extremely difficult to obtain full technical information even on engines destined for civil use.

► **Continental Air Lines is keying promotion activity in its major new markets to the Viscount 810/840 turboprops it will operate in 1958. A trailer-truck display, on loan from Capital Airlines and featuring a cut-away model of the Rolls-Royce RDa. 8 engine and a mockup of the Viscount lounge, is touring Los Angeles and will be shown in key cities on Continental's routes. The airline will inaugurate service on its new Los Angeles-Kansas City-Chicago route in April with DC-7Bs.**

► American Airlines is the first domestic airline to pass the 20,000 employment mark. Latest tabulation shows a total of 20,056 employes on the payroll. Biggest employment rise occurred during last four years when almost 5,000 people joined the airline.

► **Civil Aeronautics Board is giving the airlines and manufacturers the additional time they requested to study the proposed new turbine transport regulations in Draft Release 56-20. The deadline for comment has been moved back to Jan. 15, and government-industry discussions of the rules will be held in Washington on Feb. 1. Manufacturers plan to have their study of the proposals completed by Oct. 15, and the airlines plan to apply the information to their operations and then report by Nov. 15. After that, the groups will meet and prepare their comments for the CAB.**

► International Civil Aviation Organization will attempt to untangle legal complexities involved in crimes committed aboard international flights. Jurists from 10 countries have studied the legal status of international aircraft. Next step is to determine where jurisdiction lies. Other legal problems which ICAO hopes to resolve as international air law are those resulting from in-flight births and deaths. The group also hopes to determine the exact powers of an aircraft captain during flight.

► **Aristotle Onassis is expected to have organizational and route plans of National Greek Airlines (TAE) completed within the next few weeks. Final structure of the airline may include close tie-in with one or more airlines, either American or European.**

► Sikorsky pulled a military S-58 off the production line, removed classified gear and assigned it to share Civil Aeronautics Administration certification tests with previously built commercial model. The action was prompted by pressure from commercial buyers seeking to hasten deliveries of the helicopter. CAA objected only to dural rivets used in firewall, insisted that stainless steel be adopted.

► **Montreal's $1-million air freight terminal now being built at Dorval Airport by Timmins Aviation Terminals Ltd. is the first airport building undertaken in Canada by private interests. Seven carriers have already contracted for space in the building which will be completed in July 1957, and will be known as the Canadian Aviation Building.**

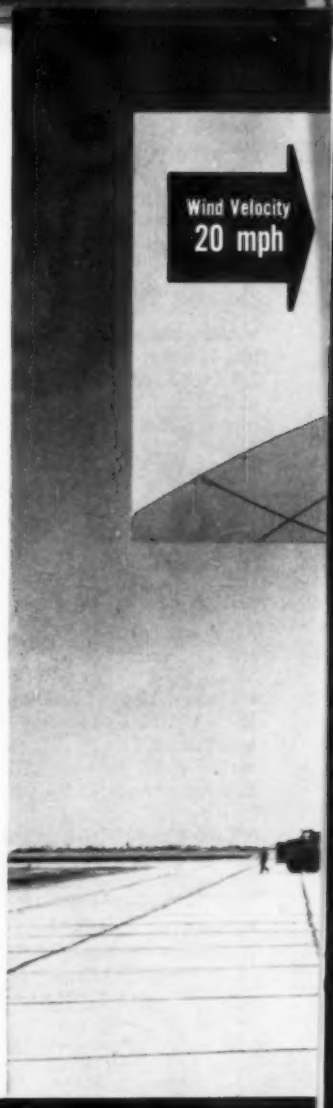
► Pakistan International Airlines plans an expansion of its routes from Karachi to London via Cairo and Rome and from Karachi to Dhahran and Bagdad. The airline also is contemplating routes that will link Karachi with Nairobi and Aden on one leg and Bangkok, Dacca and Rangoon on another. Pan American World Airways holds a technical assistance contract for PIA from the Foreign Operations Administration.

► **Caravelle jet transport recently covered the 720 nautical miles from Paris to Stockholm in the record time of two hours, 10 minutes. The transport was shown to Scandanavian Airlines System officials.**

Lead plane wins 1900-mile dash by 21.3 seconds as . . .

ALL THREE SAC B-47's BREAK SPEED MARK IN GENERAL ELECTRIC TROPHY EVENT

Bermuda-Oklahoma City race emphasizes mobility, readiness of SAC, demonstrates performance, reliability of G-E J47 engines



CONGRATULATIONS are extended to Major J. Schreiber, commander of winning plane, by General E. W. Rawlings, AMC Commander.

TROPHY PRESENTATION. (l. to r.) Capt. D. O. Peterson, Tech. Sgt. J. Richardson, Major J. Schreiber, Major C. J. Luecke, George Fouch, head of G-E jet engine manufacturing, Maj. Gen. W. O. Senter, Commander, OCAMA.

NATION-WIDE TELECAST announced event record to 30,000,000 viewers of G.E.'s Sunday night TV Theatre shortly after race ended.

Averaging 601.187 mph, SAC's 22nd Bomb Wing crew landed its Boeing B-47 only 21.3 seconds ahead of the runner-up aircraft to win the 1956 General Electric Trophy.

Near "photo finish" times logged in the 1900-mile, non-stop dash demonstrate the reliability of the General Electric J47 turbojet. Flying the race into the face of challenging west-to-east prevailing headwinds for the first time, each entry broke the existing Trophy Event B-47 speed mark of 589.294 mph set in 1955.

Eighteen engines—all with throttle settings at maximum allowable power—performed so precisely that only 144.7 seconds separated the competing bombers at the finish line.

Powerplants with this same demonstrated reliability are in service today with more than 1500 SAC B-47's. In this respect, this year's G-E Trophy Event emphasized dramatically the combat mobility and readiness of USAF's Strategic Air Command. General Electric Company, Cincinnati 15, Ohio. 235-11

ENGINEERS: Illustrated booklet "Thrust & Progress" is available for qualified engineers interested in the field of flight propulsion. Write: Technical Personnel, Dept. L, Building 100, AGT Division, General Electric Company, Cincinnati 15, Ohio.

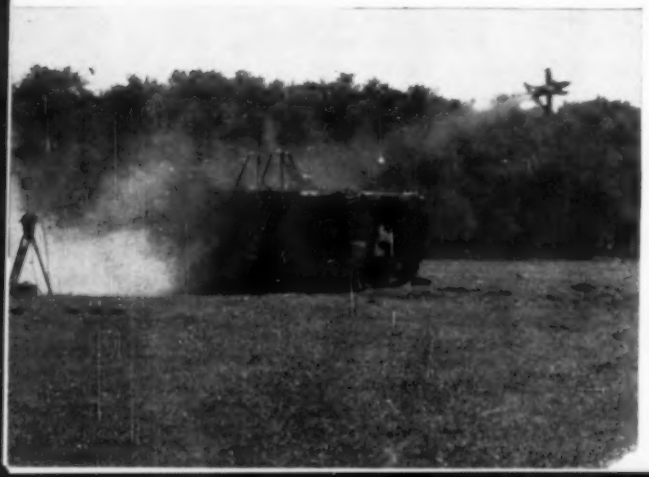
Progress Is Our Most Important Product

GENERAL ELECTRIC

MISSILE ENGINEERING

ARMY DART missile was developed for field use against tanks, uses a shaped-charge warhead. Powerplant is smokeless solid-propellant rocket; speed is subsonic.

DART GUIDANCE and launcher is built into standard M59 personnel carrier for battlefield use. Dart system is going into production for the Army.



REDSTONE tactical ballistic missile is hoisted onto firing table by 25-ton mobile crane, part of nine-unit convoy required by the missile.

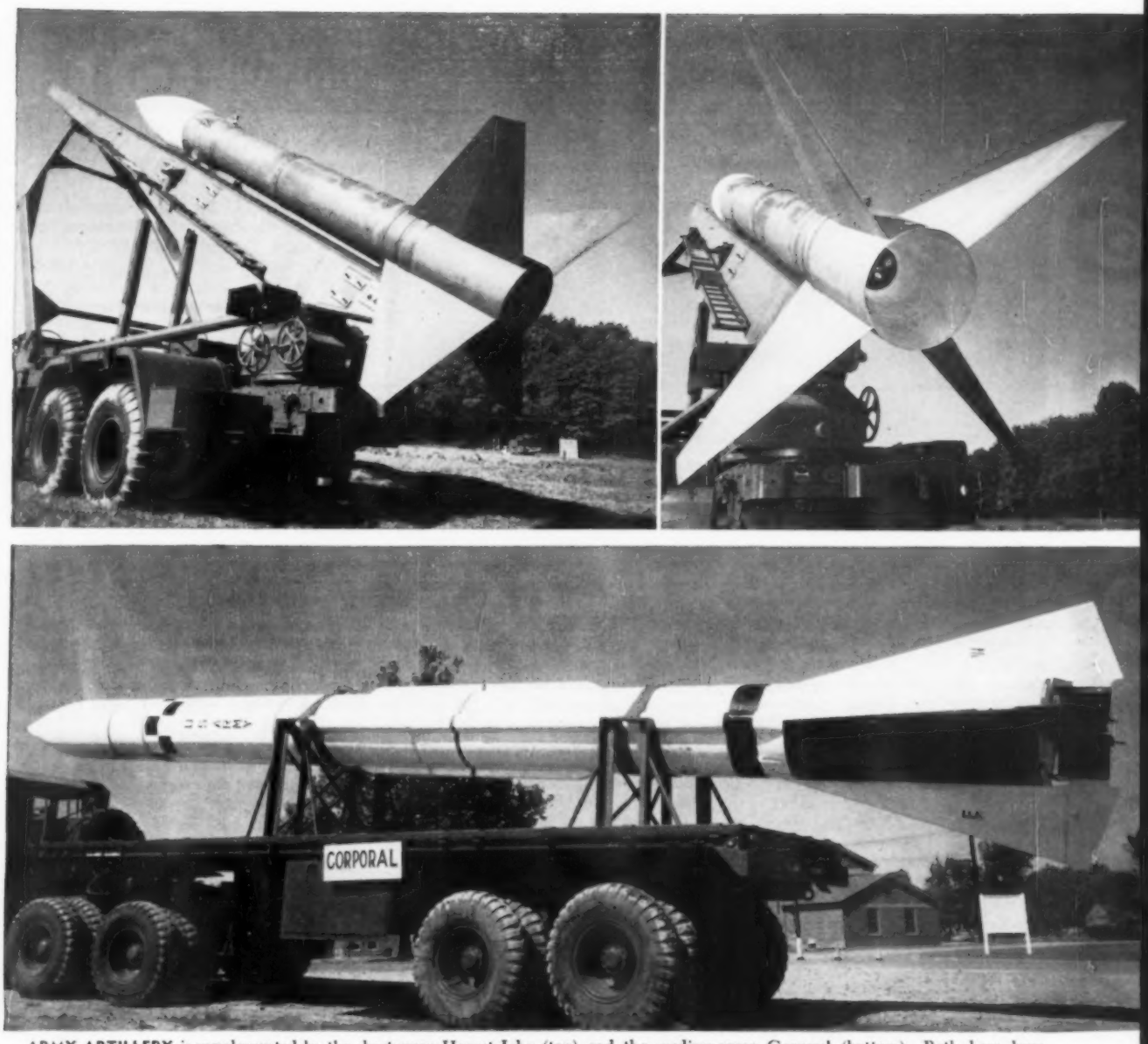
Army Shows

By David A. Anderton

Aberdeen, Md. – Army's Redstone missile system, built around a medium-range ballistic rocket, will soon become an operational weapon.

The Army says Redstone has "great accuracy, complete internal guidance and range selection." It may be a substitute for tactical airpower, Army adds.

The two-piece missile now in production by the Chrysler Corp. was demonstrated along with its convoy of handling equipment in a simulated firing to



ARMY ARTILLERY is supplemented by the short-range Honest John (top) and the medium-range Corporal (bottom). Both have been issued to field armies. Honest John is unguided, has range approaching 15 mi. Corporal is guided, can hit at targets up to ranges of 50 mi.

Missile Arsenal; Redstone Near Field Use

more than 4,000 members at the annual meeting here of the American Ordnance Association.

Six other Army missile systems were shown or described during the day:

- **Dart** (XSSM-A-23), anti-tank missile using a shaped-charge warhead and propelled by a solid-propellant rocket.
- **Lacrosse**, surface-to-surface missile for close support on the battlefield.
- **Little John** (XM47), small-caliber unguided artillery rocket.
- **Corporal** (XSSM-A-17), short-range ballistic missile.
- **Honest John** (M31), aimed artillery rocket.
- **Nike** (XSAM-A-25) anti-aircraft missile system now deployed at sites around major U. S. cities.

Redstone Convoy

Basic concept of the Army's Redstone missile is a weapon capable of taking tremendous firepower to enemy positions far beyond heavy artillery range.

The enormous two-piece missile should be able to carry atomic warheads over its useful range, which has been estimated at about 200 mi. It is considered as the forerunner of the Jupiter IRBM, now under joint development by the Army and Navy.

A nine-truck convoy makes up a firing platoon of a field artillery missile battalion equipped with Redstone. The operational use of the weapon visualizes a move to the firing point, a quick set-up and checkout of the missile, and —before firing—moving on to another site with the major items of the convoy, leaving only the missile on its

LITTLE JOHN takes off portable launcher in test firing. A scaled-down Honest John, this missile is also unguided, is about 12 ft. long and 12¾ in. diameter.

stand and the fire control point in position.

The missile itself is two-piece, not two-stage. The larger chunk is the thrust unit and includes the powerplant, propellant tanks and stabilizing and control surfaces. To this unit is mated the body of the missile which contains the warhead, the inertial guidance system and control surfaces for making trajectory corrections during flight.

Emplacement

Development of the missile began in 1951, says the Army; full effort of Ordnance Corps was committed to the program early this year.

The firing platoon rolls up to the site with the 25-ton mobile crane leading the convoy. The crane crew unloads the launching stand from its trailer and sets it on the ground for leveling by the launcher crew.

While the site is being prepared for the firing, the crane crew moves the thrust unit of Redstone from its transporter and assembles it to the body section in a horizontal position. Here Redstone gets a complete pre-flight checkout, including feeding the flight program into the missile's programmer.

The crane is again used to erect the missile on the launching stand; the crane and the empty transporter trailers now move off to the next firing point.

Alcohol, liquid oxygen and peroxide loading now take place in that order. The fueled missile is leveled and oriented on the firing table so that the axis of the stabilized platform is properly aligned with the prospective flight path toward the target.

The liquid oxygen trailer stays hooked to the missile, topping off the oxidizer continuously to replace evaporation losses. The fire control and test truck also stays hooked to monitor the missile through its fueling. About five minutes before launching, the truck disconnects and moves away to the next site.

Last mobile equipment to leave is the oxygen truck. The lines are disconnected just before the final countdown. Now only the missile and the field firing panel, installed in a nearby foxhole, are left at the firing point.

After the launching, the field panel and the firing platoon leader are picked up by truck and taken to the next site which has already been prepared for another Redstone launching.

Convoy Roster

The complete convoy for the Redstone missile platoon includes nine major units.

- **Mobile crane,** with 25-ton capacity and a 90-ft. boom. For road transport, the three sections of the boom are carried on a trailer towed by the crane.
- **Auxiliary trailer,** carrying the launching table, a power generator and the various small items used by the ground crews.
- **Fire control** and test truck, which carries all the equipment needed for checkout and pre-flight of the Redstone.
- **Two missile trailers,** one carrying the thrust unit and the other the body.
- **Three propellant vehicles,** one each for alcohol, liquid oxygen and the hydrogen peroxide that is decomposed to drive the fuel pumps.
- **Air compressor truck,** used to pressurize the pneumatic systems of the missile.

Dart Details

Dart, Army's latest anti-tank missile, was fired against a moving target 2,100 yd. downrange. The missile passed through the edge of the bull of the 8-ft. square target at nine o'clock.

Dart was developed by the Aerophysics Development Corp., and production of the missile will be handled by the Utica-Bend Corp., a wholly-owned subsidiary of the Curtiss-Wright Corp.

Powerplant of the Dart is smokeless, solid-propellant rocket manufactured by the Grand Central Rocket Co.

Guidance system is a unique optical tracking device developed by the H. A. Wagner Co. The sight and associated equipment is located in a standard M59 armored personnel carrier, which also serves as the launcher. Just before launching a sodium flare on the Dart is ignited for better observation of the flight path.

During the flight to the target, the Dart hunted visibly in pitch.

Dart is about five feet long, eight inches in body diameter and has about a three-foot wingspan. It uses a shaped charge, and will be issued to infantry and armored combat units.

Other Missiles

First details released on the Little John, a scaled-down Honest John rocket used for much the same purpose, show the new missile to be of 318 mm. (about 12.5 in.) caliber. Length overall is about 12 ft.

It is handled, transported and launched much like its big brother. It is unguided, but aimed by the position of the launcher in azimuth and elevation.

Little John is being built at Redstone Arsenal.

Lacrosse, the close-support missile being developed by Army for its own and the Marine's use, was announced but not displayed at the meeting. Complete development of the missile system, including the truck-mounted launcher and the guidance station, was done at the Cornell Aeronautical Laboratory. The missile is being produced at Martin Baltimore.

'Deadly Accuracy'

The missile has four sweptback wings and four fins, and is rocket-propelled (AW Sept. 17, p. 27). Test firings completed at White Sands Proving Ground this summer have shown the Lacrosse to be a "deadly accurate weapon."

Lacrosse was designed at Cornell to a Marine requirement outlined in 1947. Development contract was signed in 1949.

Johns Hopkins University's Applied Physics Laboratory cooperated in the feasibility study of the weapon which began in 1947. Martin is participating in the continuing development of the weapon system.

ENGINEERING BULLETIN

ON MICRO-BEARINGS

Miniature Instrument Ball Bearings

NEW HAMPSHIRE BALL BEARINGS, INC.

PETERBOROUGH 1, NEW HAMPSHIRE

Subject: **DYNAMIC AND STATIC LOAD RATINGS**

DYNAMIC LOAD RATINGS

Load ratings of MICRO bearings are based on standards established by the Anti-Friction Bearing Manufacturers Association and are the result of extensive tests.

The "life" of an individual bearing is defined as the number of revolutions which the bearing makes before the first evidence of fatigue develops. Fatigue, in turn, is a function of bearing load and although other factors, such as contamination and high temperature, affect the life of a bearing, it is assumed that clean bearings running at normal temperatures are being considered.

It is not possible to predict the life of any individual bearing. The problem, therefore, is best approached by a consideration of empirically derived dispersion curves which provide a means of determining bearing life on a probability basis. That is, they permit the average life of a given group of bearings to be accurately specified.

For purposes of standardization, the "rating life" of a group of apparently identical ball bearings is defined as the number of revolutions that 90% of the group will complete or exceed before the first evidence of fatigue develops. This figure is approximately one-fifth of the average life.

If two groups of similar bearings are run under different loads F_1 and F_2 within the normal operating range of loading and rpm, their lives L_1 and L_2 are inversely proportional to the cubes of the loads, i.e.,

$$\frac{L_1}{L_2} = \left(\frac{F_2}{F_1}\right)^3$$

The BASIC LOAD RATING C is that radial load which a group of apparently identical bearings can endure for a rating life of one million revolutions, with stationary load and rotating inner ring. Within normal operating ranges the rating life for any load *is a constant number of revolutions*, so the following relationship, a restatement of the inverse cube proportion, may be used to compute rating life when basic load rating and applied radial load are known:

$$L = \left(\frac{C}{P}\right)^3$$

L = rating life in millions of revolutions
where, C = basic load rating in pounds
P = applied radial load in pounds

The nomograph illustrated permits the quick evaluation of any one of the three quantities when the other two are known. For example, if the C rating of a given bearing is 95 pounds, and the bearing is loaded radially with 12 pounds, P, a straightedge crossing these two values in their respective columns shows that the bearing could be expected to have a life, L, of 450 million revolutions.

DEFINITION OF EQUIVALENT LOAD

Bearings whose loads are primarily radial are usually also subjected to axial forces. When the axial component of the load is greater than a negligible value, this combined radial and thrust load may be expressed in terms of a simple radial load in order that the basic load rating C may be calculated. This simple radial load is known as the "equivalent load", which is that constant stationary radial load which, if applied to a rotating inner ring, would give the same life as that which the bearing will attain under the *actual* conditions of load and rotation.

FORMULA FOR EQUIVALENT LOAD

For conventional bearing types other than those with filling notches, the equivalent radial load is given by the maximum of the two values:

a)	$P_r = VF_r$	X is a radial factor
b)	$P_r = XVF_r + YF_a$	Y is a thrust factor
where,	V is a rotation factor	F_r is the radial load
		F_a is the thrust load

The factor e represents the ratio of $\frac{F_a}{VF_r}$ for which the two equations are equal. If the ratio of loads is such that $\frac{F_a}{VF_r} \leq e$ then formula (a) is used: if $\frac{F_a}{VF_r} > e$ then formula (b) is used.

For inner ring rotation V = 1.0 in all cases; for outer ring rotation V = 1.2 in all cases except for self-aligning bearings, where V = 1.0. In most calculations involving MICRO bearings, the following values are sufficiently accurate: X = 0.30, Y = 1.04, and e = 0.67. In the case of self-aligning bearings, however, X = 0.40 and Y = 7.6.

In practice, the angular contact type of bearing should not be subjected to a predominantly radial load unless opposed by another bearing.

When a bearing is loaded and at rest the dynamic life formula $\left[L_x = \left(\frac{C}{P}\right)^3\right]$ cannot be used because when $L_x = 0$ then $P = \infty$. Obviously there is a limit to the Static load which the bearing can carry, this limit being determined by permanent deformations which develop in the load carrying surfaces. Such deformations appear even under very light loads and increase gradually with increasing load, with no sharply defined limit beyond which they begin. The static load limit is dependent on the permissible magnitude of deformation, consistent with requirements of quietness and freedom from vibration. Experience indicates that a permanent deformation in the raceway of less than 0.0001 times the diameter of the rolling elements ordinarily has no objectionable influence on the functioning of the bearing.

In order to obtain an expression for the load carrying capacity at rest, and a numerical value that can be used as a reference, the pure radial load which corresponds to this negligible magnitude of permanent deformation has been selected as the basic static load rating and given the designation C_o.

If the load is much higher than C_o when the bearing is not rotating, minute depressions are formed in the raceways, causing the bearing to be noisy and to vibrate when operating at high speed, even though the bearing friction is not noticeably increased or the bearing otherwise injured. Depending on the requirements in this respect, the static load may occasionally be allowed to exceed the C_o value.

If a load considerably higher than C_o acts only while the bearing rotates, the permanent deformations that occur will be evenly distributed in the raceways and cause no serious impairment until the deformations become relatively large. However, under such a heavy load, the fatigue life will be comparatively short in terms of the number of revolutions. Static load rating values for all MICRO bearings are presented in our catalog-data book.

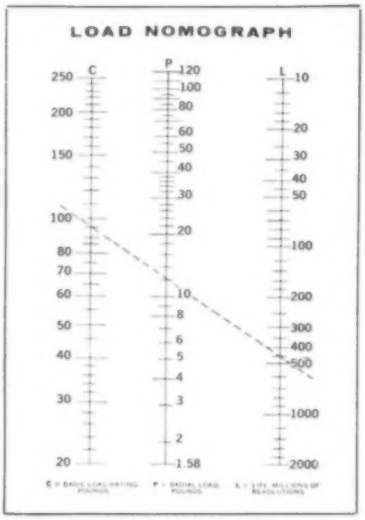


FIG. 1. *Typical cut-away views of instrument-type retainer ball bearings. Complete tabular data on "C" factors and static load ratings are contained in the MICRO Bearings Catalog.*

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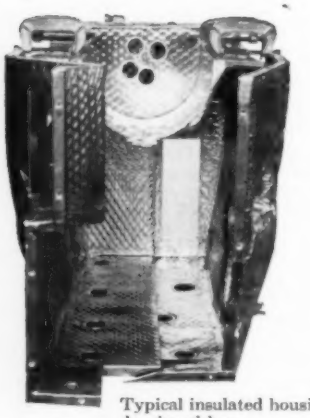

Typical insulated housing developed by Johns-Manville for vital aircraft component.

In the *flying furnace* that is today's jet aircraft—or missile—components must still deliver maximum performance. That's why so many manufacturers of actuators, starters, pumps and electrical equipment are turning to insulated housings as developed by Johns-Manville. These housings are tailor-made for each component design. They fit snugly and form a continuous barrier against the scorching temperatures encountered at supersonic speeds.

Carefully fabricated of high-heat-resistant alloys, Johns-Manville housings are insulated with Thermoflex® refractory fiber felt. They are light in weight yet possess unusual structural strength and rigidity.

If your component is subject to failure from high temperature, get in touch with Johns-Manville. Experienced insulation engineers will plan a housing to give your component the protection it needs.

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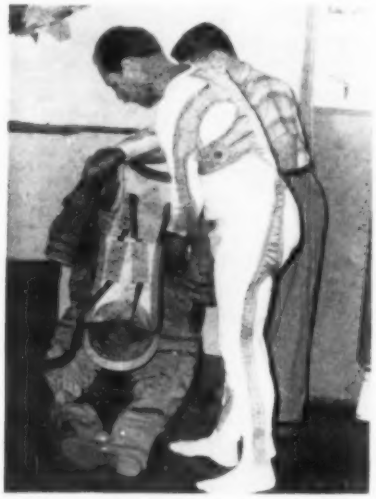
Johns-Manville PRODUCTS FOR THE AIRCRAFT INDUSTRY

Omnienvironment Suit

CHANCE VOUGHT'S chief test pilot, John Konrad, is ready to take off in new omnienvironment pressure suit developed by the Navy and B. F. Goodrich Rubber Co. Suit completely encloses pilot who breathes 100% oxygen from takeoff.



SPECIAL underwear has tubes venting air into suit for ventilation.

MAN in ordinary Navy flight getup; Konrad in Navy-Goodrich suit.

PILOT climbs into cockpit where adjustments are made. Suit protects against low atmospheric pressures, heavy G forces, heat, cold, and exposure in water after bailout.

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portable
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Model 5500
AIRLINE OXYGEN ASSEMBLY

• This lightweight, constant-flow unit provides up to 100 minutes of supplementary oxygen for passengers or crew with disposable or conventional rebreather masks. Shoulder strap for convenient use as "walk-around" unit. This equipment is also used to augment or substitute for fixed systems. The 5500 unit is made to the same high standards that has made Scott equipment outstanding for over 20 years in a perfection-demanding industry.

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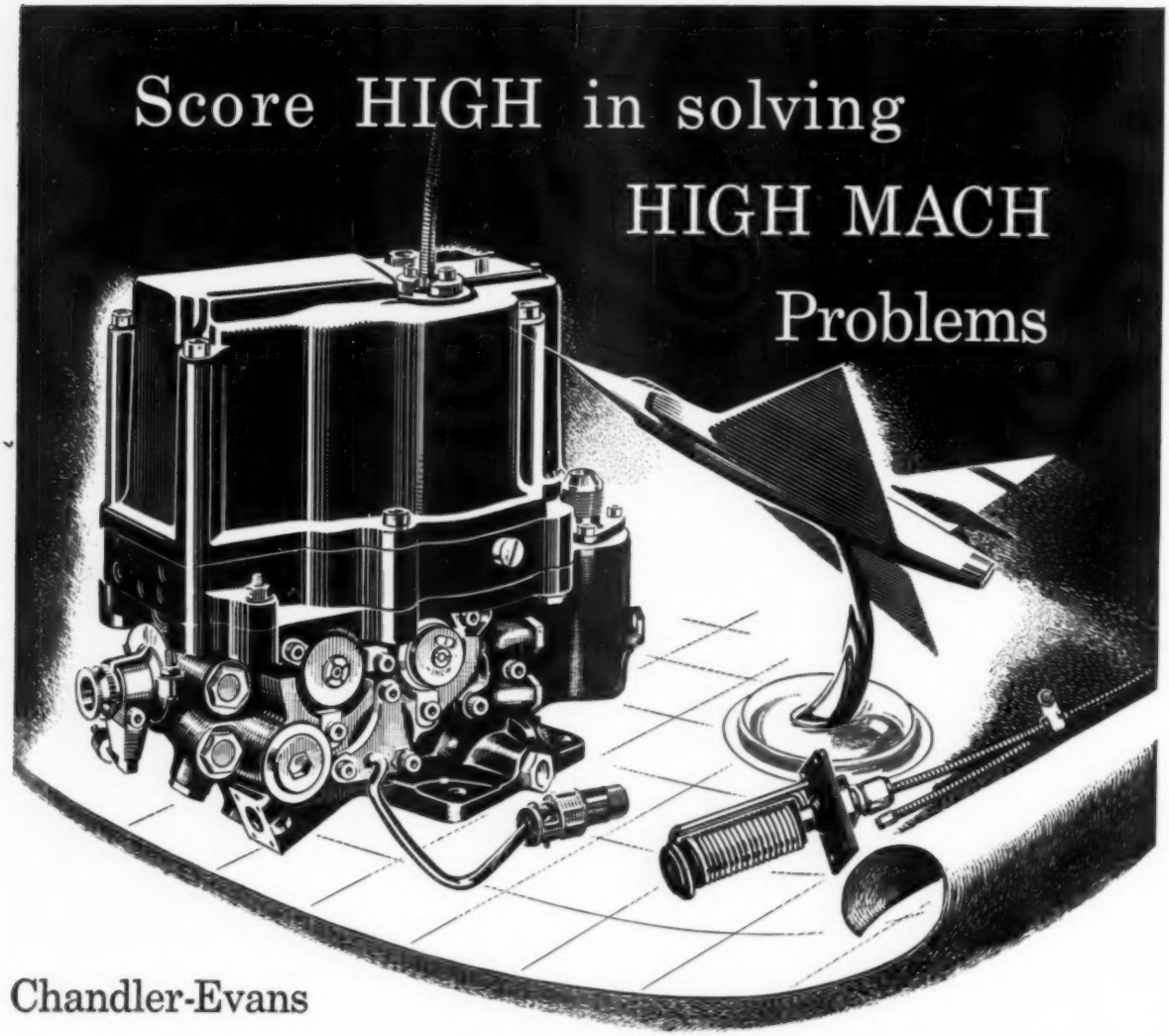
Score HIGH in solving HIGH MACH Problems



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HIGH MACH at extreme altitude creates heat problems that cripple conventional fuel systems. CECO has already created new control designs that solve many such problems.

Save time... take advantage of the advanced research and development at CECO which provide the fuel control systems and components to solve YOUR high Mach problems.

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Makers of Jet Aircraft Accessories Produced TODAY to meet TOMORROW'S Progress

ARTIST'S DRAWING of Convair's 880 medium-range turbojet transport. The craft has been ordered by Trans World and Delta Airlines.

Convair 880 Details Show Flexibility

Detailed specifications of Convair's 880 turbojet transport which have been sent out to prospective buyers portray an airplane that overlaps areas of performance of the long-range turbojets and the shorter-range turboprops but does not fit into either class.

Guaranteed performance for the airliner, on order by Trans World Airlines and Delta Airlines (AW June 18, p. 40), includes:

• **Takeoff distance** at sea level over a 50 ft. obstacle (1.2 V_{s1} used for takeoff speed) with weight of 155,000 lb.–6,550 ft.

• **Landing distance** at sea level (intended destination) over 50 ft. obstacle with weight of 123,500 lb.–5,650 ft.

• **Range,** with starting weight of 155,000 lb. and a total fuel weight of 45,000 lb.–1,475 nautical miles.

(The fuel weight includes 2,500 lb. for warm-up, takeoff and acceleration to climb speed [no distance made good], cruise at 35,000 ft. and 90% rpm. cruise thrust, descent, zero wind and 10,000 lb. reserve fuel. Tolerances for the range is ±3% and for the takeoff and landing distances ±5%.)

Maximum allowable takeoff weight is 173,500 lb. Maximum landing weight is 123,500 lb., but a maximum structural landing weight of 130,000 lb. can be provided with a change in wheels and brakes, increasing the empty weight of 80,800 lb. by 75 lb.

Airspeeds guaranteed:

• **At 25,000 ft.,** maximum cruise thrust and 130,000 lb. weight–527 kt. ±3%.

• **At 35,000 ft.,** 90% rpm. cruise thrust and 150,000 lb.–475 kt. ±3%.

En route operating altitude with one engine inoperative and at a weight of 165,000 lb. is specified at 18,500 ft. ±10%.

Convair provided additional takeoff and landing performance figures that were not listed in the formal specifications:

• **For 500 mi. trip** with an 80 passenger, 21,700-lb. payload and takeoff weight of 128,000 lb., takeoff distance would be 4,150 ft.; landing distance (weight 117,000 lb.) 5,400 ft.

(In a tourist configuration of mixed first-class and tourist accommodations, the model 880 will carry 108 passengers.)

• **For 1,000 mi. trip,** with 80 passengers and a total weight of 148,000 lb., takeoff distance would be 5,750 ft.; landing distance, 5,400 ft.

• **For a 3,000 mi. trip** (maximum range), with 80 passengers and maximum takeoff weight, the takeoff distance would be 8,300 ft. and landing distance 5,400 ft.

These landing distances are guaranteed figures within ±5%. The takeoff figures are not guaranteed figures, but are drawn from a curve established since the guaranteed specifications were set out.

Design cruising speed is 375 kt./Mach .89. Main landing gear, which will retract sideways into the fuselage and wing root can be extended at 375 kt. for use as emergency drag device. Speed limitation with full flaps is 195 kt.

In general, the airplane structure will be high strength aluminum alloy, including 2024, and for less critical areas, 7075 and 7178. Aluminum alloy sheet shall be clad for gages .063 in. or less where used externally. The structure will be fail safe, either through use of multipath structure or by providing overstrength in the appropriate members.

The fuselage, which will be pressurized to a maximum normal operating value of 8.2 psi., will have structural arrangement and stress level so that skin cracks will not result in explosive structural failure.

Allowance is made for use of honeycomb where structural requirements permit.

The airframe envisioned currently is a conventional one. Its details, which are spelled out in general terms:

• **Wing.**

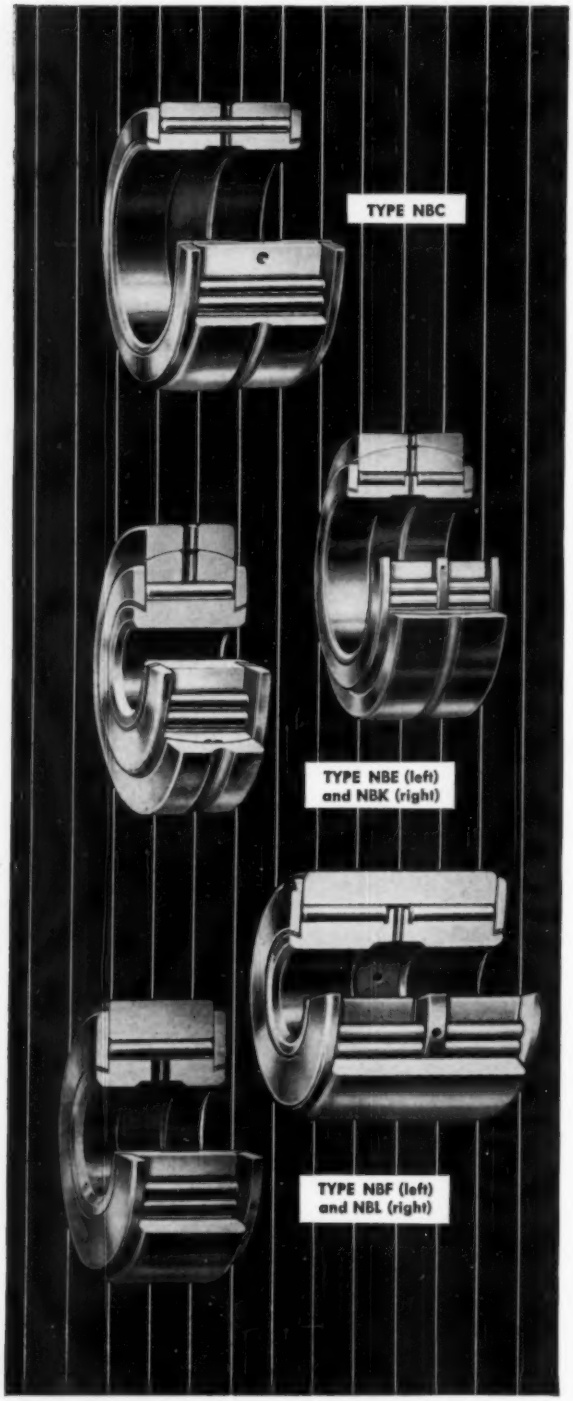
Airfoil section NACA 0011-64 mod. at root, NACA 0009.08-64 mod. at 31.4% semi-span, and NACA 0007-64 mod. at tip. Dihedral 5 deg. at trailing edge, semi-span to tip; sweep, 35 deg.; aspect ratio, 7; mean aerodynamic chord, 18 ft. 11.2 in.; area, 2,000 sq. ft.

Construction in general will be of aluminum alloy, full cantilever, box type with multiple spanwise spar members of built-up type, ribs and bulk-

TORRINGTON

NB SERIES NEEDLE BEARINGS

For Oscillating Motion or Heavy Rolling Loads



Torrington NB Series Needle Bearings employ the same needle roller principle as the famous DC Type Bearing.

They are available in the five types illustrated, all being of nonseparable construction and designed for periodic relubrication. Outer and inner races are of high carbon, chrome steel, hardened and precision ground.

Like the DC Type, the compact design of NB Series Needle Bearings permits saving in size and weight of surrounding parts.

Torrington NB Series Needle Bearings have been used extensively in the aircraft industry and for ordnance work where their extremely high static capacity and anti-friction characteristics enable them to withstand heavy impact loads.

Designs can be modified to meet industrial applications involving rotating motion.

Type NBC—oscillating motion only. Designed specifically for applications in which the OD is supported by a housing and the washers are backed up by clamping surfaces.

Types NBE and NBK—oscillating motion only. Self-aligning. Designed for applications where it is difficult to obtain alignment during assembly or where deflections make a self-aligning bearing desirable.

Types NBF and NBL—heavy rolling loads. Designed for use as rollers under heavy loads at slow speeds.

See our new Needle Bearing Catalog in the 1955 Sweet's Product Design File—or write direct for Catalog No. 55.

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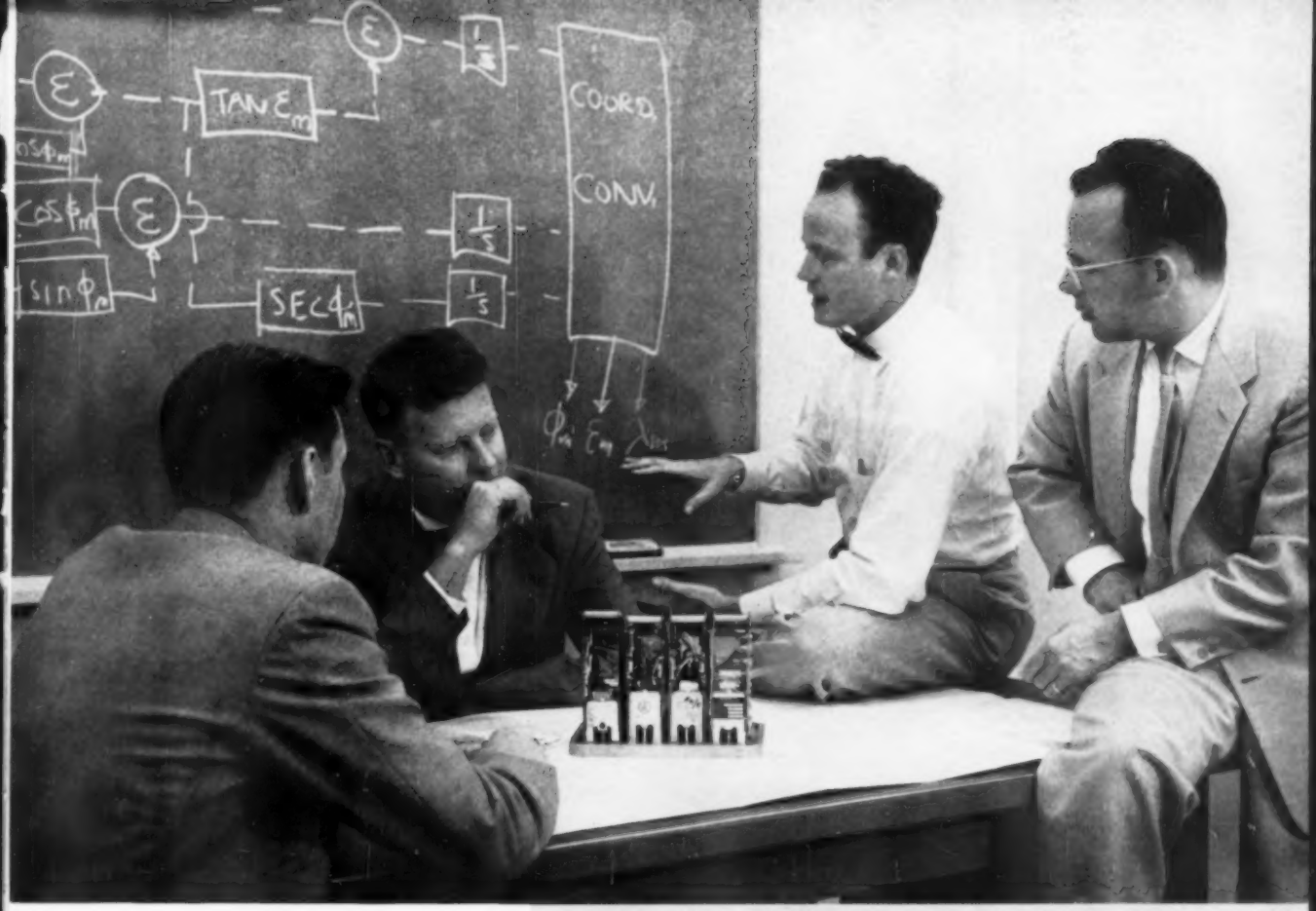

G. D. Schott (second from left), Flight Controls Dept. Head, discusses new techniques in the mechanization of autopilots with R. D. Wertz (left), Flight Controls Research Engineer; R. J. Niewald, Flight Controls Analysis Section Head; and B. C. Axley, Servomechanisms Analysis Group Engineer.

MISSILE SYSTEMS FLIGHT CONTROLS

One of the most critical problems encountered in the development of a successful missile system involves attaining rapid responses of controls *consistent with system stability*. Moreover, it is a problem of increasing importance as new aerodynamic configurations require major advances in flight controls performance.

At Lockheed, Flight Controls engineers are developing unique control methods to cope with this growing problem. Their expanded activities have created new positions for those possessing experience and a high order of ability in:

- Hydraulic servomechanisms
- Circuit design
- Aerodynamic stability and control
- Flight analysis
- Autopilot simulation

A number of the positions now open are on supervisory levels. Inquiries are invited for positions at Lockheed's Engineering Centers in Van Nuys and Sunnyvale, California.

Lockheed **MISSILE SYSTEMS DIVISION** *research and engineering staff*

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Ranging over sea, desert, or frozen wastes, the Air Rescue Service's Douglas C-54s are an "anywhere—any weather" safety lifeline for downed airmen and disaster victims.

Greater speed and economy make the C-54 Skymaster ideal for both actual rescues *and* the long patrol missions Air Rescue Service flies. Increased fuel capacity keeps C-54 aloft for 18 hours or more. *One* plane can drop 4 new-type raft rescue kits with a life-saving potential of 160 people.

Defense is everybody's business. Global responsibilities tax our armed forces' manpower to the limit, and meeting them is a matter of national defense and national pride. Young Americans are urged to find out about the opportunities to serve their country and advance their futures in the service of their choice.

Depend on *DOUGLAS* First in Aviation

heads of truss and web type and plate stringer type upper and lower surfaces.

Four integral fuel tanks of 10,770 gal. capacity, with a weight allowance for fuel of 70,000 lb., are provided.

• **Engines.**

Four General Electric CJ-805-1 turbojet engines (commercial J79s) will be attached to permanent pylons. Thrust reversers and sound suppressors are to be included and an allowance of 12,200 lb. has been made in the weight empty for the engines with these units. Compressor bleed air will be used to pressurize the fuel tanks and for wing anti-icing.

• **Tail group.**

Stabilizer and fin will be of aluminum alloy full cantilever construction with provision for electrical deicing. Elevators and rudder will be aerodynamically and mass balanced.

• **Fuselage.**

Semi-monocoque construction incorporating transverse frames and longi-

Missile Tracker

Optical trackery, developed at the Army Signal Corps Engineering Laboratories at Ft. Monmouth, N. J., can track a moving plane or missile 300 mi. in natural color through a 160 in. lens. Lens system for the revolving equipment weighs 400 lb. It was developed by Fairchild Camera and Instrument Corp. Camera, also designed by Fairchild, photographs target and a clock on same frame. Auxiliary camera photographs data display which indicates elevation and azimuth and also a second clock synchronized with first. Tracker was photographed at White Sands Proving Grounds.

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precision
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Globe, the pioneer precision miniature motor manufacturer, now enters the field of larger, yet compact and lightweight a.c. motors for operation at all frequency ranges and speeds. The new motors measure 1.675" dia. x 2¼" long, and weigh only 11.5 ozs. Incorporating Globe's latest advancements in hysteresis-synchronous design, they provide absolute synchronous rotation, extremely smooth operation, and high starting and running torque of 1.2 oz. in. For precise timing and control uses, units are available with integral planetary gear heads in a broad selection of even speed reduction ratios and torques up to 3500 oz. in.
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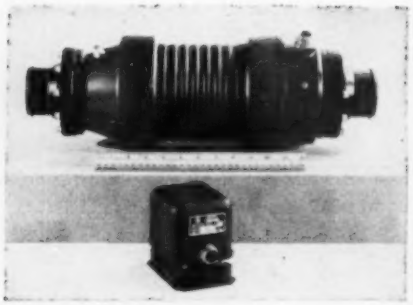
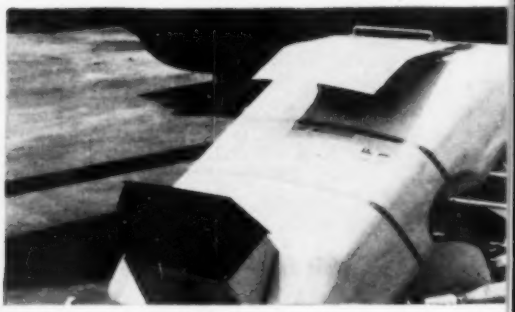
Five Examples of How General Electric

1 G-E TURBODRIVES AND TURBO-PUMPS convert air from engine compressors on the B-52 into drive-power for the giant bomber's generators and hydraulic-power for landing gear, bomb-bay doors and other hydraulically-actuated devices.



2 G-E AIRCRAFT INSTRUMENTS, serving the B-47, include unique mass fuel flowmeters for in-flight refueling which are capable of measuring up to 10,000 pounds of jet fuel per minute with accuracy within one per cent. Flowmeter systems include transmitters, power supplies, and indicating instruments.



3 NEW G-E J79 TURBOJET, delivering more power per pound than any engine of comparable size, receives run up test in B-45 flying test bed. Now in production for the Lockheed F-104A, world's fastest fighter, the J79 is joining the more than 31,000 turbojet engines pro-

These are just a few results of General Electric progress in the development of advanced aircraft equipment. Today G-E engineers and scientists are applying the extensive resources and facilities at their command to explore the mysteries of hypersonic missile and aircraft flight in a continuing effort to provide the advanced equipment necessary for a strong air defense tomorrow. General Electric Company, Schenectady 5, N. Y.

210-102A

Helps Strengthen America's Air Power

duced by General Electric for the Air Force since 1941.

Every 24 hours at USAF bases around the world, G-E turbojets are flying 5,500,000 miles, or the equivalent of an airline with 340 four-engine transports.

4 NEW G-E CONSTANT FREQUENCY POWER PACKAGE produces 20 KVA from a 105-pound system. This lightweight development is based on the 9-KVA constant drive speed used on the A4D and generators and controls equipping the F-101A fighter-bomber and B-66 bomber.

5 G-E ELECTRONIC BOMBER DEFENSE SYSTEMS correlate and compute target, environment and ballistic data thru an integrated radar-eye and electronic-brain to give split-second directions to B-52, B-47, and B-66 tail armament.

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Dependable, simple—the solid-propellant rocket is unique in America's arsenal. Its power is instantaneously unleashed, its performance unaffected by atmosphere and actually improved by altitude. Aerojet-General's jet-assisted takeoff units (JATOs) are the world's most widely used auxiliary power-plants for aircraft.

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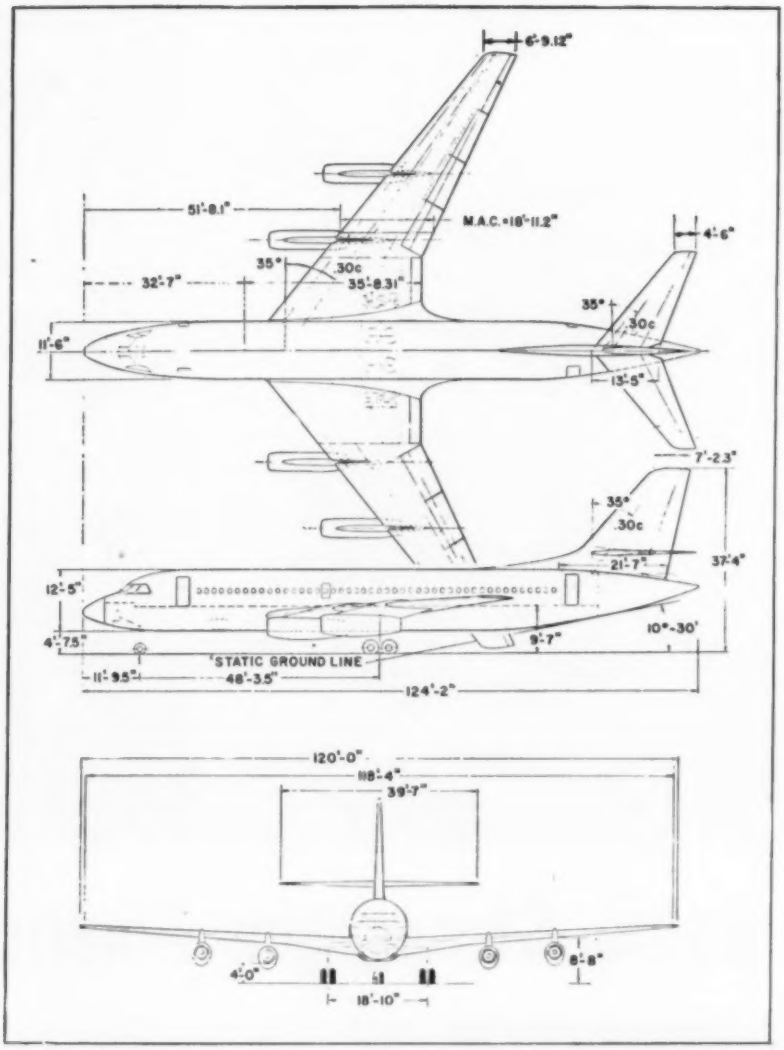
Write: Director of Scientific and Engineering Personnel, Box 296N, Azusa, Calif, or Box 1947N, Sacramento, Calif.



LATEST Convair 880 specifications show little basic change from earlier dimensions. Landing gear width has been reduced eight inches, rudder height from ground three inches. Span and length of conventional layout remain the same.

tudinal stiffeners with aluminum alloy sheet covering will be used. Blowout panels may be used to minimize possible injury to crew and passengers in the event of sudden decompression. Weather radar antenna will be mounted in the nose.

• **Landing Gear.**

Tricycle type will be hydraulically retractable. Main gear will incorporate two sets of four-wheel main trucks mounted aft of the center of gravity. Nose wheel will be steerable dual type.

• **Controls.**

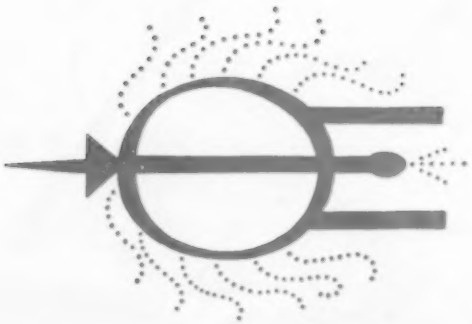
Ailerons and spoilers will be used for lateral control. Ailerons will be manually controlled and automatically locked out whenever the flaps are retracted and operative when flaps are extended. An emergency override will be provided to unlock the ailerons for use below 245 kt. with flaps retracted.

Spoilers will be hydraulically operated for use at all speeds, and will have two independent hydraulic systems.

Rudder and elevators will be manually controlled. Controllable stabilizer will be controlled hydraulically, with a standby electrical actuating system available. Flaps will operate hydraulically. Spoilers will be used for speed brakes. Fail-safe yaw damper will be provided.

French Study Missile For Vatour Bomber

Ouest-Aviation (formerly Sncaso) is carrying out research in field of guided missiles, especially in regard to Vatour bomber's armament. Research also includes long-range ground-to-air missile which will be ultimate development of Trident.



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er-Rammah's self-moving egg

Join two flat pans; fill with an incendiary mixture; add a tail; propel by two large rockets. In A.D. 1280, Arabia's Hassan er-Rammah, gazing centuries ahead, proposed this ovoid in his "The Book of Fighting on Horseback and with War Engines."

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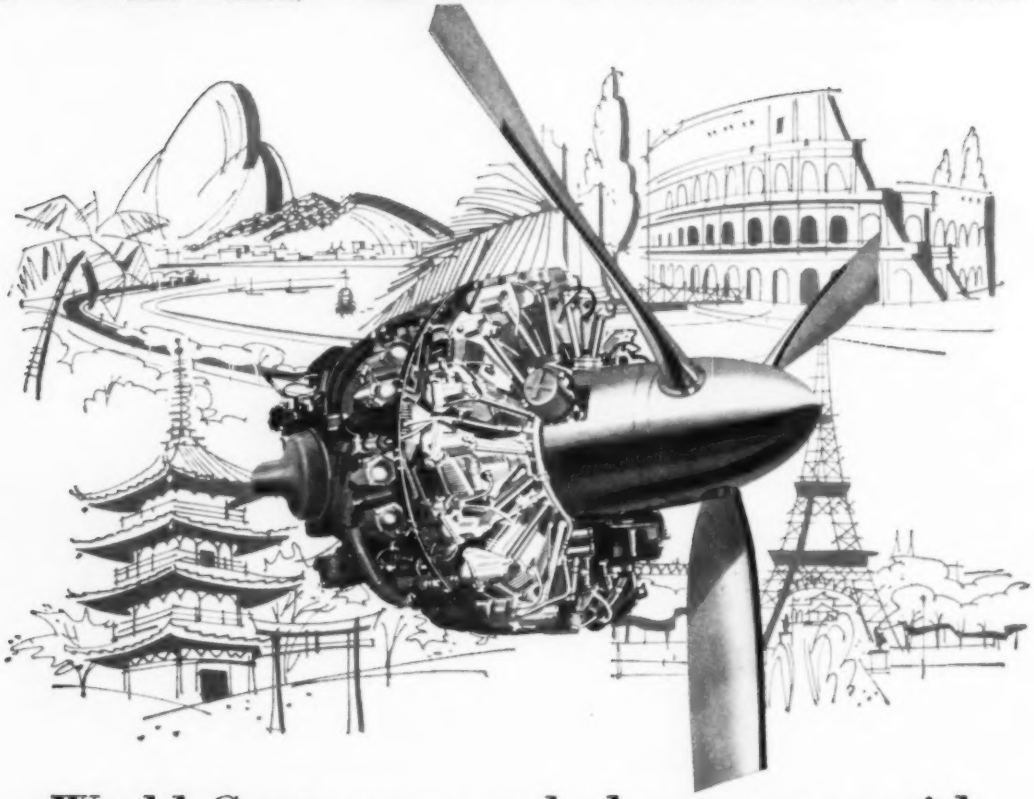
FOREIGN ...but not far



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Wind, Temperature Predict Sonic Boom

By Russell Hawkes

Rough prediction of whether sonic boom from aircraft at high altitude will reach the ground has been made possible by a recently published USAF study.

The study report says that if the ground speed of an aircraft at altitude is less than the ground speed of sound at the surface, the shock wave will not reach the ground. The ground speed of sound will be affected by temperature and wind velocity. The latter will also affect the ground speed of the aircraft.

Shock Front

Prediction of sound at the surface would be easy in a homogeneous atmosphere in which temperature and wind were the same at all altitudes. A shock wave front would form a straight line extending downward from the generating airplane at the Mach angle and traveling in a direction perpendicular to its length. It would reach the ground from a dive, level flight or even a slight climb unless the altitude of the airplane was great enough to permit its complete decay.

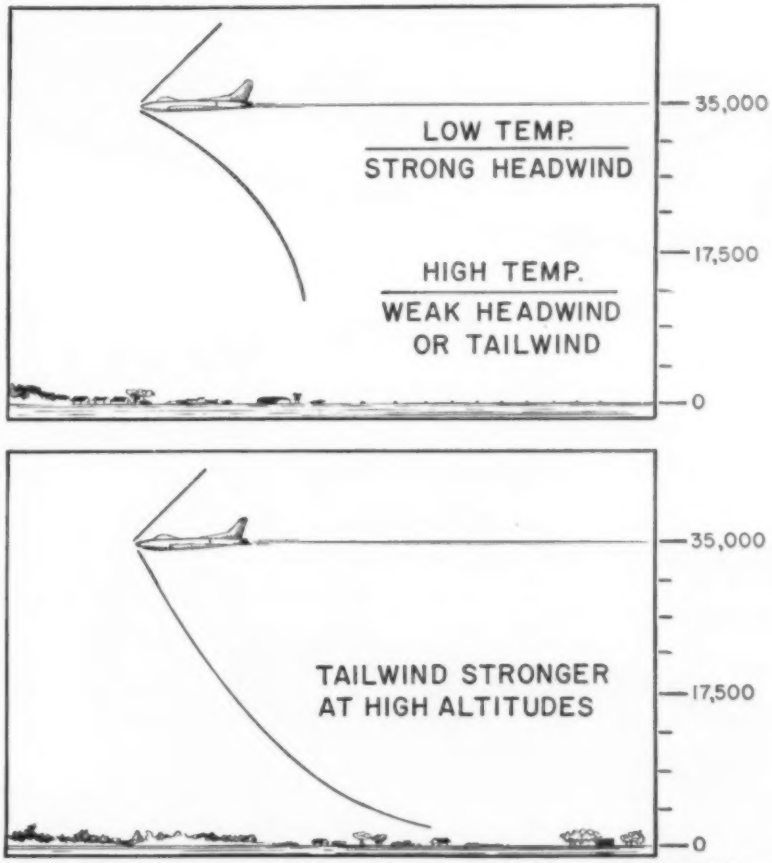
In practice, vertical temperature and wind gradients will prevent the front from reaching the surface if the ground speed of sound there is greater than the ground speed of the airplane. Because the shock wave travels at the speed of sound which rises with temperature, its lower portions gain speed as they descend to lower altitudes. As a result the lower edge of the shock front curves forward and continues at an angle more nearly parallel to the ground, decreasing the likelihood of its reaching the surface as an audible boom.

Upwind Pass

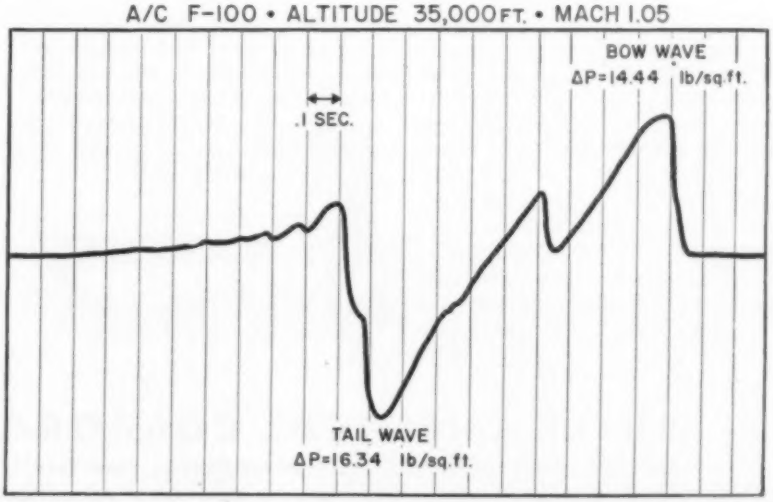
The same swing forward and upward usually occurs in a supersonic pass into the wind. The slowing effect of surface friction tends to disappear with altitude so that winds aloft are usually much faster than those on the ground. Therefore, as the lower parts of the front move down into lower headwinds, ground speed increases and the front is warped forward.

In a downwind pass the reverse is true. The ground speed of the shock wave decreases with altitude and the front bends backward causing it to advance toward the ground.

At very high Mach numbers a boom is to be expected regardless of the temperature and wind gradients because the Mach angle is great enough to overcome these effects even in a



USUAL TEMPERATURE, wind gradients make it less likely for boom from upwind run (above) to reach ground. Shock accelerates at low altitude, swinging up and traveling longer, slanting path to ground. Downwind, (below) front decelerates in slower surface winds, bending backward and following steeper, shorter path to ground.



SHOCK 100 ft. to right and level with F-100 has steep bow wave, smaller wave from wing and tail wave which is most intense. Further from plane, waves diverge, flatten.

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Epon adhesives have been used successfully in the manufacture of helicopter rotor blades, honeycomb wing sections, jet fuel tanks, radar antennae, structural joints and floor panels. In many cases, Epon adhesives are replacing expensive riveting and welding operations—often with improved structural strength.

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- **Epon Adhesive 422:** A special formulation in tape form for service at temperatures up to 500°F.

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slight climb. With no wind and a normal temperature gradient, one could expect to hear a boom from a Mach 1.15 pass at 35,000 ft.

Distance Decay

The study shows that shock waves decay with distance and the rise between free air pressure and pressure in the shock wave conforms closely to theory. Pressure rise depends largely on the pressure altitude of the free air and distance from the generating airplane.

At a pressure altitude of 35,000 ft. and a distance of 100 ft. the pressure rise was found to be from 12 to 14 lb./sq. ft. Extrapolation to sea level pressure indicates that the pressure rise in a low pass would be about 60 lb./sq. ft. enough to cause considerable damage.

Rate of decay with distance is rapid. At a distance of 500 ft. the pressure rise is less than half that at a distance of 100 ft. and at 1,000 ft. it is down to 3 lb./sq. ft. Rise in the tail wave (recompression) was almost invariably greater than that in the bow wave.

Mach 1.05 Runs

Data for the study was obtained from Mach 1.05 runs at 25,000 ft. and 35,000 ft. by an F-100 accompanied by an instrumented chase plane which measured shock wave phenomena at varying distances to the right of and below the test plane. Very high Mach number dives failed to yield any quantitative results because the trace was driven off the record.

Chase plane pilots reported that the shock wave is potentially dangerous to overtaking aircraft because it causes them to yaw toward the generating airplane.

Aside from the possibility of collision this may create dangerously high side loads on the tail surfaces.

Derivimeter Fills In for Calculus Training

Instrument called a derivimeter allows engineering aide, untrained in calculus, to compute derivative or slope of a curve at a given point with accuracy comparable to that obtained by usual methods.

Value of the normal to the curve is found in a similar manner.

Derivimeter consists of a flexible metal strip which can be adjusted to follow the shape of the curve. A light pointer is mounted in and perpendicular to the strip. It indicates the value and the positive or negative sign of the derivative on a circular scale.

In using the instrument, grid lines are aligned with graph lines on a chart or drawing. Scale, strip and pointer assembly is rotated so that center of strip is roughly tangent to the curve at the desired point. Strip is then adjusted to the shape of the curve by means of set screws.

Gerber Scientific Instrument Co., 162 State St., Hartford 1, Conn., is the manufacturer.

Workshop Is Scheduled for Training of Managers

A workshop for manager development has been scheduled for early 1957 in New York by Dunlap and Associates, Inc., Stamford, Conn.

The workshop, given 24 times during the past three years, is intended to help develop managers more rapidly, thoroughly and economically than has been possible.

It has a twofold technique: first, to make the individual aware of the needs of the company, himself and other people, and second, to equip the individual with skills to apply his awareness of these needs.

The course extends over a period of ten weeks, with one two-hour session each week.

Further details: Dr. Bernard J. Covner, Dunlap and Associates, 429 Atlantic St., Stamford, Conn.

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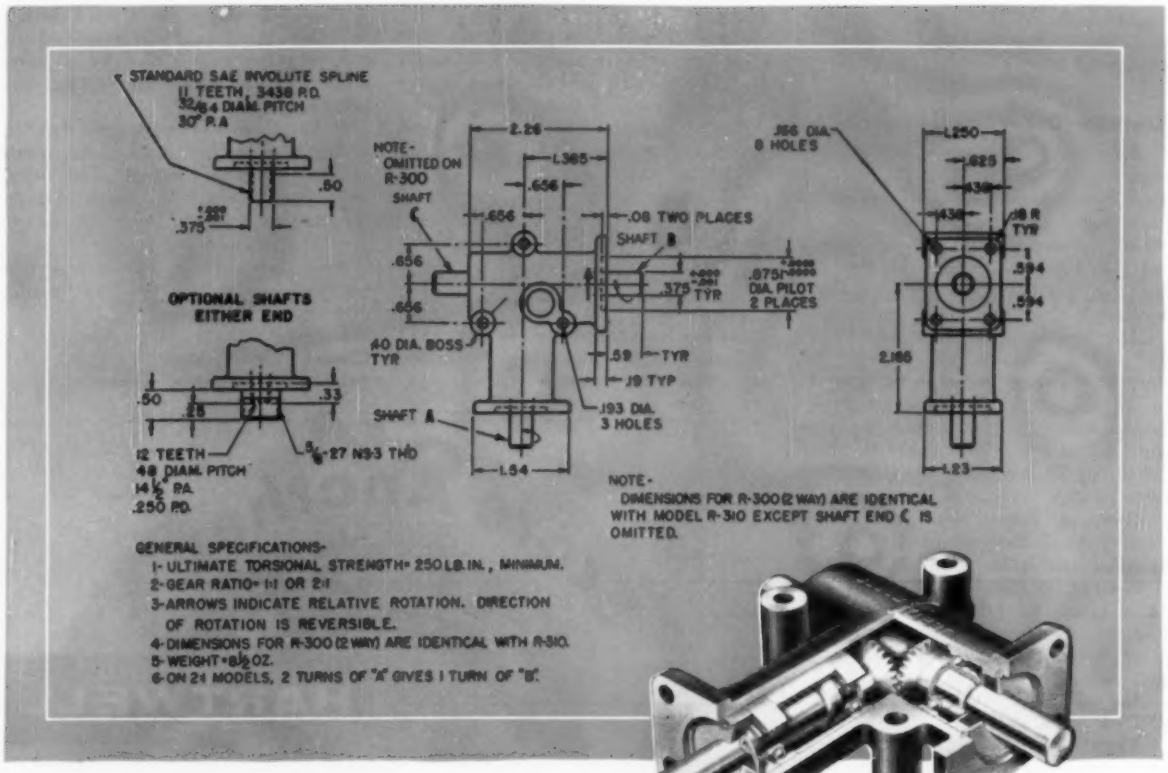

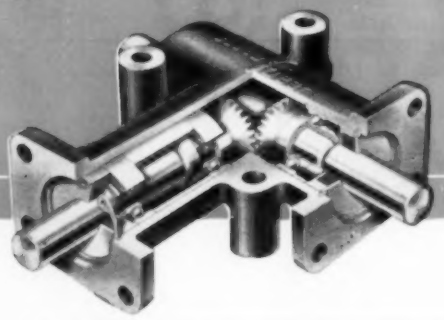

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Need a right-angle gear drive? You can make one yourself. Here's all you need: a set of Coniflex* gears, a precision-cast housing, antifriction bearings, and shaft extensions. Put these together, lubricate the unit for life, test it for quietness (noise means future trouble), and you have a right-angle drive. Too expensive, you say? That's why we would urge you to buy ANGLgear, a compact, standardized take-off that has won the respect of designers everywhere.

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Model & Type	Ratio Turns "A" to Turns "B"	HP Output	RPM Shaft "B"	Ultimate Static Torque (lb in)	Shaft dia (Inches)	WT (lb)
R-300 2-way	1:1	⅓	1800	450	⅜	½
R-300-2 2-way	2:1	⅓	1800	450	⅜	½
R-310 3-way	1:1	⅓	1800	450	⅜	½
R-310-2 3-way	2:1	⅓	1800	450	⅜	½
R-320 2-way	1:1	1	1800	1500	⅝	2.2
R-320-2 2-way	2:1	1	1800	1500	⅝	2.2
R-330 3-way	1:1	1	1800	1500	⅝	2.4
R-330-2 3-way	2:1	1	1800	1500	⅝	2.4

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Data Processing Speeds Navy Air Supply

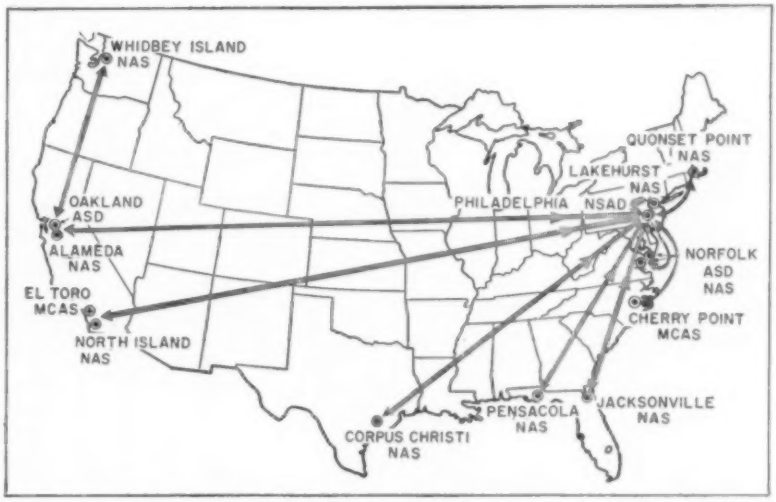
By George Christian

Philadelphia—Two new types of electronic equipment recently put into service at the Navy's Aviation Supply Office here—one a machine, the other a group of machines which form a system—are allowing the office to streamline its vast procurement, distribution and inventory control operations.

ASO's inventory comprises almost a half million parts and the organization does an annual business of $500 million.

The Navy's air arm operates about 75 different basic models of aircraft, both jet and piston-engine powered, which mount 30 different models of engines of both types.

One unit is an International Business Machine 702 Electronic Data Processing Machine which digests quantities of input data and puts out large amounts of information to pinpoint for the Navy what should be stocked where and when, what parts are in oversupply or short supply and many other facts the Navy needs to keep its far-flung air arm operating at peak efficiency.



NAVY'S transceiver network includes 14 Naval Air Stations and Supply Depots. Entire network, feeding into Philadelphia, will be in operation by spring of 1957.

IBM 702 Electronic Data Processing Machine is type currently installed at Navy's Aviation Supply Office in Philadelphia. Newer 705 machine will supplant it next year.

Second Unit

The other unit, also an IBM product, is a transceiver, which is a modified card punch machine with a telephone signal attached. In one minute, one transceiver can transmit over a long line all the information contained on 11 punched cards. The receiving transceiver reproduces identical information on its cards. This system of electronic information transmission greatly expedites such jobs as stock status reporting. Previously these were hand-typed on nine-part forms which were sent to destination through the mail—a time-consuming process cluttered with paperwork.

Current plan is to transmit shipment requests from the field to ASO each night. The requests will be waiting for the shipping clerk first thing each morning.

Ideally, the requests would be processed that day and action documents sent to the field the following night, providing 24 hour service.

Prior to the 702's installation, it took about 90 days for a man in the field to get an answer to his stock report. With the help of the 702, this time was sliced to 43 days average. Teaming the 702 with the transceiver network should shrink this cycle to 20-25 days—a 400% improvement over the old system.

Data Processing Machine

"The electronic data processing machine seems to represent a breakthrough in the mechanics of inventory control," Navy officials said.

"The supersonic age in aviation has led to the electronification of our supply procedures. The support of the complex jet aircraft the Navy has deployed throughout the free world plus the high mobility of 'gypsy' planes which can move half way around the world in a day or two presents the Navy's supply personnel with procurement and distribution problems which cannot be properly solved without

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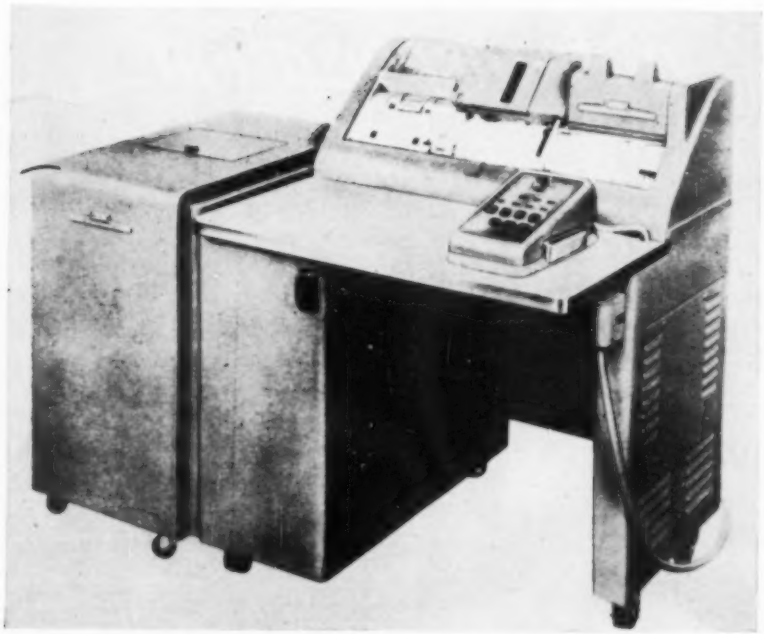


IBM transceiver of type used to send stock reports from field to Philadelphia.

highly automated data processing systems.

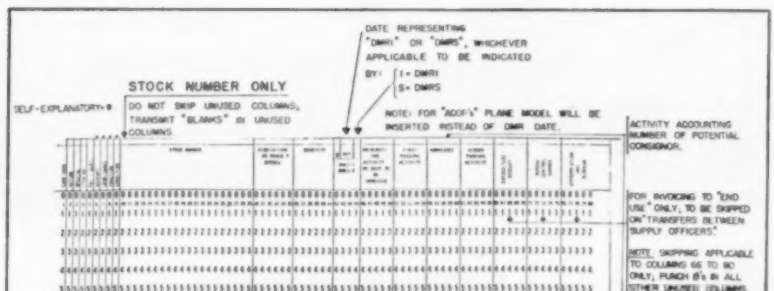
"To match the accelerating requirements of supply support of the Naval aeronautical establishment, the Aviation Supply Office has always been faced with the twin basic problems of how to predict future demand more accurately and how to take supply action more expeditiously."

Here is the fundamental problem which the 702 helps to solve. It tells the Navy what spare parts to procure and where to send them to keep inventories at such a level that spares are always available when needed, but the stock room is never overburdened with excess or obsolete parts. What the Navy wants from the electronic data processing machine is where and when to send what spare parts so that, wherever a plane may be, it will not be AOCP—aircraft out of commission for parts, or ANFE—aircraft not fully equipped.

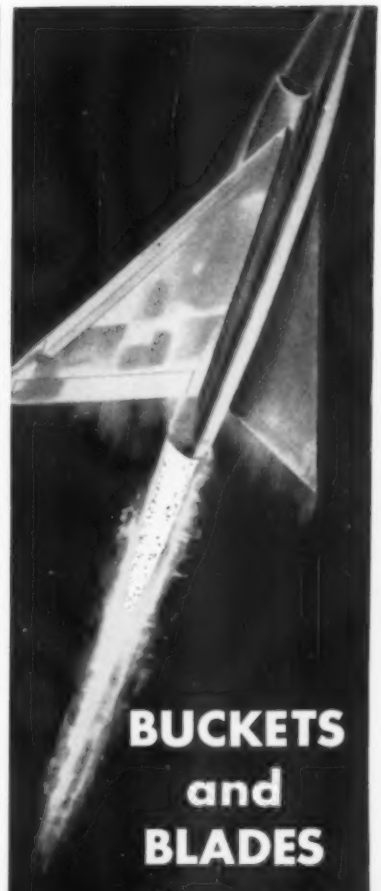
The Navy has devised a program usage replenishment system which, for certain categories of material, takes care of the spares problem. Hub of the system is at Philadelphia.

From each of the Navy's 60 stocking points comes an up-to-date report of stocks on hand. (Increasing numbers of these reports are coming over the growing network of transceivers).

From the Chief of Naval Operations


STOCK NUMBER ONLY
SELF-EXPLANATORY
DO NOT SKIP UNUSED COLUMNS, TRANSMIT "BLANKS" IN UNUSED COLUMNS
DATE REPRESENTING "DMRI" OR "DMRS", WHICHEVER APPLICABLE TO BE INDICATED
BY: 1= DMRI
8= DMRS
NOTE: FOR "AOCP's" PLANE MODEL WILL BE INSERTED INSTEAD OF DMR DATE.
ACTIVITY ACCOUNTING NUMBER OF POTENTIAL CONSIGNOR.
FOR INVOICING TO "END USE" ONLY, TO BE SKIPPED ON "TRANSFERS BETWEEN SUPPLY OFFICERS"
NOTE: SKIPPING APPLICABLE TO COLUMNS 66 TO 80 ONLY, PUNCH 8's IN ALL OTHER UNUSED (BLANK), EXCEPT STOCK NUMBER.
ACTIVITY ACCOUNTING NUMBER OF SECOND ACTIVITY UNABLE TO SATISFY DEMAND, PUNCHED BY SECOND ACTIVITY WHEN FORWARDING TO NEXT ADDRESSEE.
ACTIVITY ACCOUNTING NUMBER:- PASSED REQUISITION:- ORIGINATOR; SHIPMENT ORDER:- CONSIGNEE; INTERIM REQUISITION:- ORIGINATOR.
ACTIVITY ACCOUNTING NUMBER:- PASSED REQUISITION:- FIRST PASSING ACTIVITY; SHIPMENT ORDER:- "SOCP" NUMBER; INTERIM REQUISITION:- SAME AS ORIGINATOR

SAMPLE IBM punched card of type used with transceiver to supply stock information.



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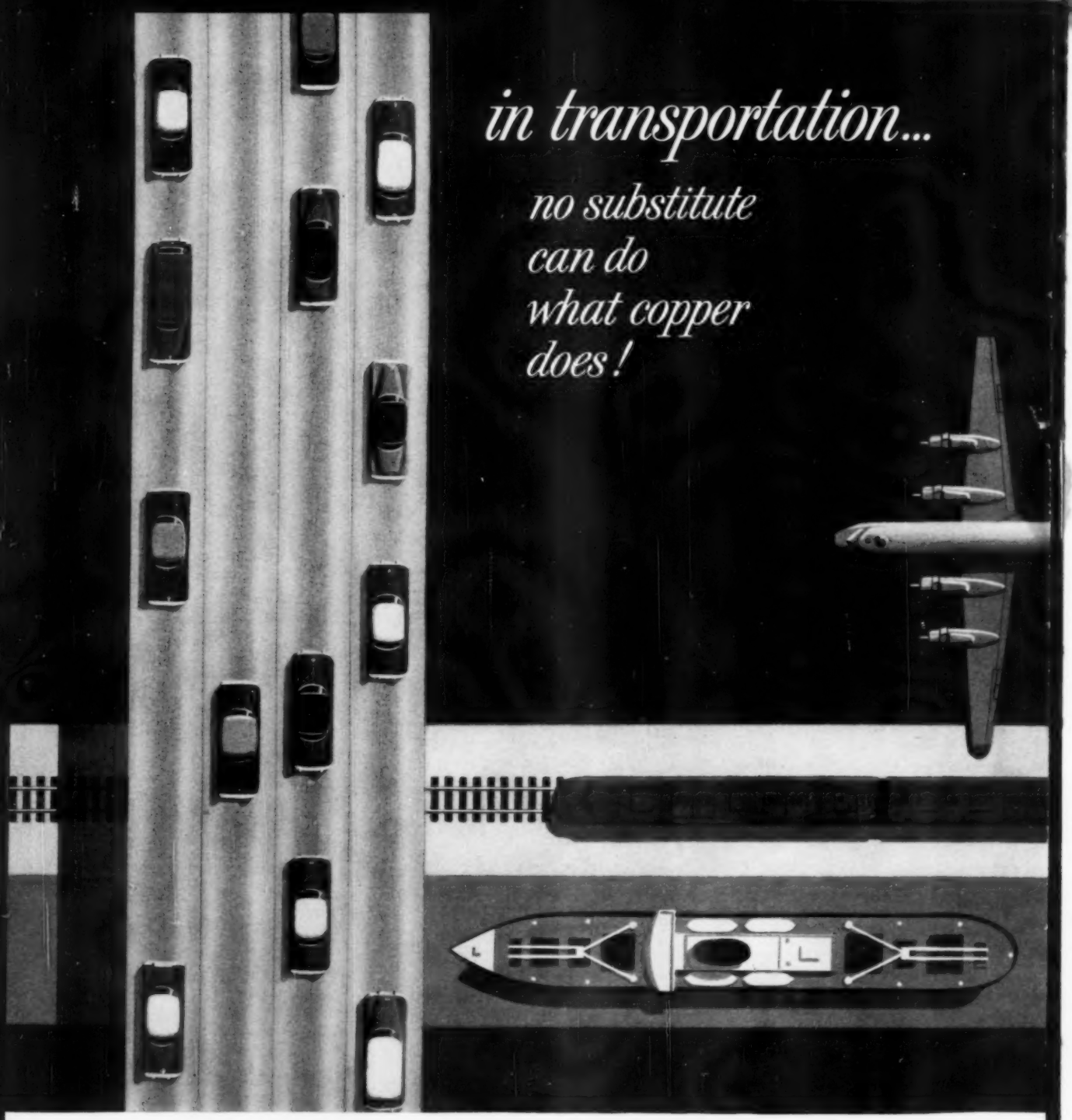

Copper carries electricity and conducts heat better than any other non-precious metal. None is so easily formed into such variety of intricate parts. No metal combines to so great an extent this supreme "workability" with the enduring properties of resistance to rust, corrosion, and wear. No effective substitute has ever been found with all the qualities of copper and its alloys... in transportation or in scores of other fields!

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in the Pentagon comes a record of where every Naval airplane will be for the next several months.

From maintenance officers throughout the Navy, come regular reports listing how often each aircraft part is used.

When these data are fed into the 702, it can "think ahead" and tell the Navy what supplies will be needed where and when. The machine can also tell procurement and supply personnel whether to buy new parts which are in short supply, or whether to pull parts from another base which is oversupplied.

After the 702 has digested all this incoming data, it can determine what each base will need for the next nine months and what the entire Naval air arm will need for the foreseeable future.

Aside from this type of report, the 702 produces other significant reports automatically.

Here are four examples:

- **Procurement analysis** keyed to manufacturer's lead time for the part. Some items must be ordered 36 months in advance.
- **Report concerning** retention and disposal quantities. Because 702 tells the Navy the total quantities of parts which will be needed, economical quantity purchases may be made. Also, if a part is obsolete, mass disposals may be made, providing room for active stocks.
- **Schedule for routing** worn parts to repair shops and sending spare parts to the shops so that they arrive concurrently with worn carcasses.
- **Catalogues which** give parts lists and technical and engineering information.

The 702, which was put into operation at the beginning of the year, is initiating considerable savings in other areas. Among them are:

- **Reduction** of the number of aircraft grounded for parts. Grounding can cost $500 a day excluding the temporary loss in combat strength—potentially a much more valuable commodity.
- **Elimination of** much paperwork at headquarters and in the field, thus releasing personnel for other, more productive jobs.
- **Increase of per** capita production among supply personnel.

705 Next

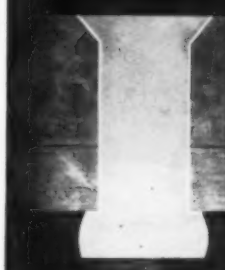
The 702 machine has been so successful in its work at ASO that the Navy is planning to expand its use of electronic processing by installing five or six 705 electronic data processing machines—faster, more advanced successors to the obsolescent 702. It hopes to install the first by spring.

Navy cites these examples of the 705's advantages:

- **702 reads** its information, then writes

Pastushin

FLUID-TIGHT JACKETED RIVETS



This photomachrograph of a sectioned specimen illustrates the sealing principle of the Pastushin Slug Rivet. Standard sizes 5/32"—3/16"—1/4"... other sizes available.

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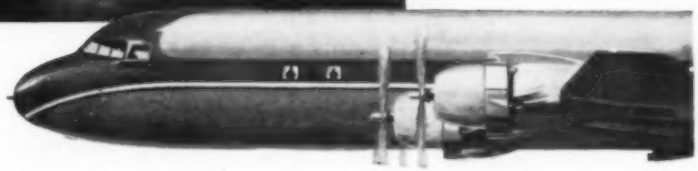

Flight tested by millions of rugged air miles flown by the finest commercial and military aircraft. Pastushin Fluid-Tight Rivets automatically seal themselves when they are driven, without the use of conventional sealants.

Sealing is accomplished by the use of a soft aluminum sleeve which extrudes into any wall cavity as the rivet is being driven.

Pastushin Rivets are available for immediate delivery—Here is just a partial list of users:

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CALIFORNIA EASTERN AVIATION, INC.
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CAPITAL AIRLINES, INC.
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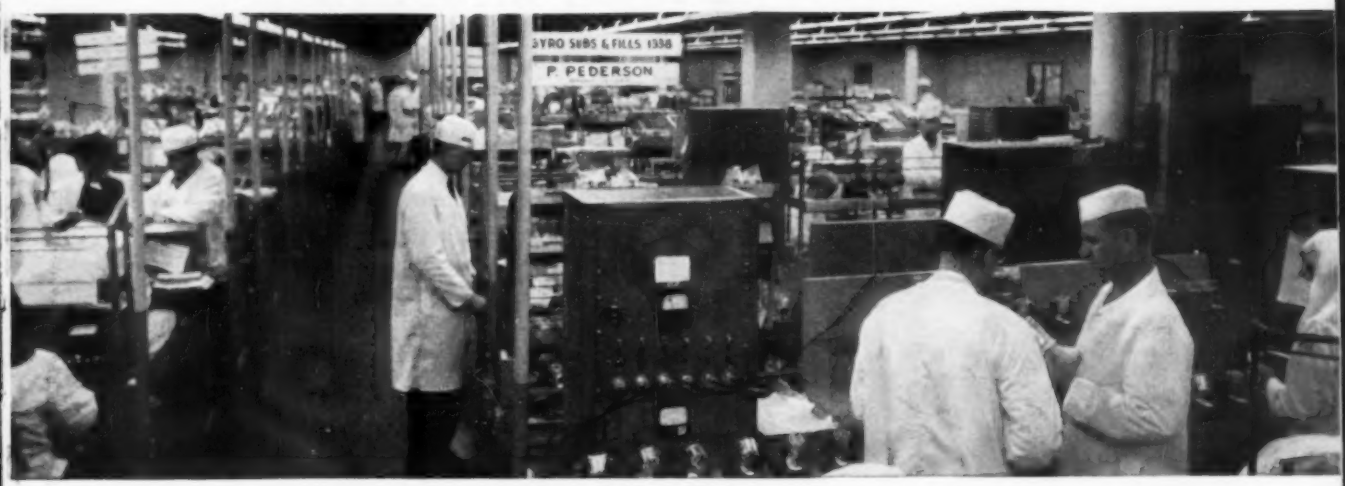

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The Navy's new fighter-interceptor, the McDonnell F3H-2N Demon, joins the Pacific Fleet, with General Electric G-3H Flight Control System.

How General Electric Flight Control System Improves F3H-2N Demon Effectiveness

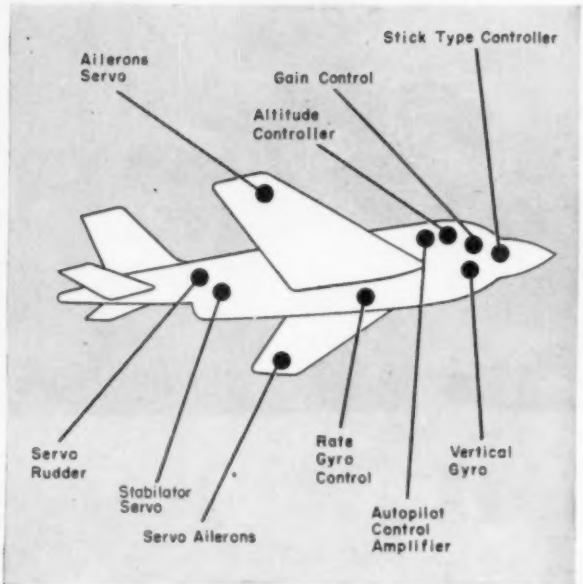

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FIG. 1

The relative motion between the inner and outer Gerotor teeth causes the oil chamber to be variable – slowly opening to maximum as it passes the inlet port – slowly closing as it passes the outlet (See Figure 2). This makes for a steady relatively pulseless flow – regardless of outside pressure changes. Thus, turbulence is minimized and foaming is avoided, efficient pumping being maintained at all altitudes.

FIG. 2

▸ **Gerotor pumps are simple** and compact in design, valveless and have high volumetric efficiency due to the fluid-tight engagement of the Gerotors which maintain high suction at high pressure. Further, this continuous contact pressure is maintained for life because of the hunting tooth principle.

▸ **Jet engine** lubrication and scavenge service are common Gerotor pump applications. In addition they are frequently specified for heliocopter transmissions and pumping of coolants for electronic equipment in aircraft and guided missiles.

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the answer in consecutive operations. The 705 reads the second problem while writing the answer to the first, thus practically doubling the machine's capacity. The 702 currently handles about 125,000 separate items. The 705 should be able to handle 250,000 items.

• **705 has improved** "memory" which is more flexible and which will produce more valuable by-products, permitting improved management techniques.

Two aspirations which may become possible with the 705 are:

• **Management by exception**, whereby the machine does all the routine work –up to 80% of the day-by-day workload. Human decisions are required only in exceptional cases.

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ASO is currently converting a warehouse into a modern data processing center to house the 705s. After the first 705 is put into operation, the second machine will replace the present 702. Succeeding 705s will be installed as received.

Transceiver Network

Navy's 14 primary stock points are gradually being linked to ASO by transceivers operating on six long lines, five of which terminate at ASO.

The six lines and the stations they serve are:

• **Line 1A:** Oakland, Calif., Aviation Supply Depot; Alameda, Calif., Naval Air Station; North Island, Calif. Naval Air Station; El Toro, Calif., Marine Corps Air Station.

• **Line 1B:** Whidby Island, Wash., Naval Air Station. (This is the one line that does not terminate at ASO; instead it is linked to Oakland.)

• **Line 2A:** Quonset Point, R. I., Naval Air Station; Lakehurst, N. J., Naval Air Station.

• **Line 2B:** Norfolk, Va., Naval Air Station; Norfolk, Va., Aviation Supply Depot.

• **Line 2C:** Philadelphia Aviation Supply Depot (separate line).

• **Line 3A:** Cherry Point, N. C., Marine Corps Air Station; Jacksonville, Fla., Naval Air Station; Pensacola, Fla., Naval Air Station; Corpus Christi, Tex., Naval Air Station.

There are also radio links with Barber's Point, Hawaii, Naval Air Station and Yokosuka, Japan, Navy Supply Depot.

Current transceiver stations in operation are Quonset Point and North Island Air Stations and Oakland ASD.

Full network operation is expected by the spring of 1957.

Two identical punched cards are used with the transceivers. One is a working card which directs a shipping

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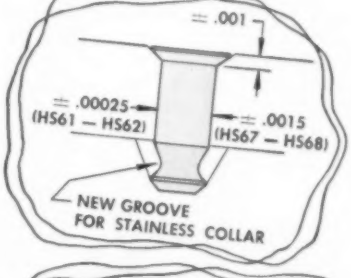

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activity to send a certain consignment to a specific location; the other serves a permanent record card.

Among other steps being taken by ASO to increase the efficiency of procurement practices are:

• **Initiation of** a system whereby aircraft parts may be procured directly from the prime contractor (instead of going through ASO) during the first 12 months of the airplane's introduction to the fleet or deployment overseas, whichever occurs first.

• **Approach to** contractors to use transceivers to report such information as aircraft order or delivery status.

• **Institution of** mechanized provisioning documentation. This concept was originally proposed by the Aircraft Industries Assn. and was taken over and implemented by ASO. Under the plan the spare parts provisioning team, which visits each airframe manufacturer building a plane for the Navy, returns from the contractor with a deck of electronic accounting machine punched cards. These immediately establish the ASO technical file for that particular airframe. This file generates a spare parts order within 15 days of an airframe contract—two to three times faster than the previous (and current) procedure.

Basis of Plan

Basis of the plan is to transfer, at the airframe contractor's plant, considerable technical information about the aircraft on to electronic accounting machine cards.

This data would include such items as: plane effectivity, parts recoverability or repairability, "make or buy" (should a component be bought or manufactured). These cards form the ASO technical file.

Mechanized provisioning documentation was first put into operation with Lockheed Aircraft Corp. on the T2V-1 jet trainer. The procedure will be used for a second Navy plane being built by Lockheed. And Glenn L. Martin will probably be the second Navy airframe contractor to begin using the scheme.

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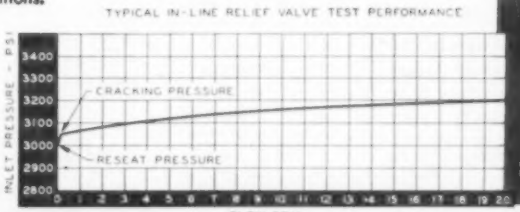

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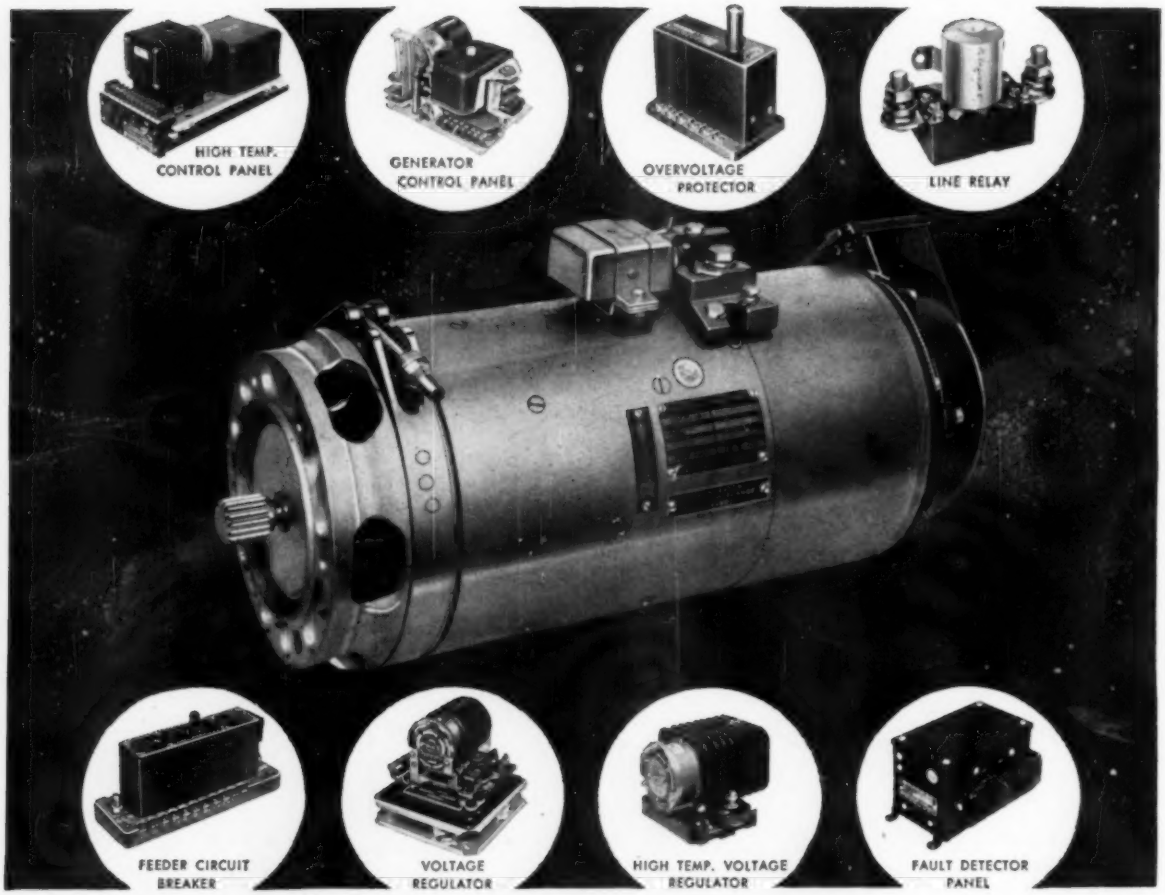

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30E16	100	2500–4500	50,000	40	52B6588
30B33*	100	4700–8000	35,000	28	MIL-S-9181
30E07	200	3350–8000	50,000	45	AN-3632
30E20	200—Class C 300—Class A	4000–8000	65,000	45	MA-1
30E02	300	3450–8500	25,000†	64	—
30B37	300—Class C 400—Class A	4000–8000	65,000	53	—
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New Technique Offers SSB Alternative

By Philip J. Klass

Utica, N. Y.—Synchronous detection, a new technique for high frequency radio receiver design which provides many of the anticipated features of single sideband (SSB) using existing amplitude modulation (AM) transmitters, was revealed here at the Second Annual Symposium on Aeronautical Communications.

The new technique, reported by General Electric's Dr. John P. Costas, could eliminate the problem of equipment compatibility during any transition from AM to SSB, and it can be used to receive single sideband transmissions. GE has built and delivered to the Rome Air Development Center a synchronous detection receiver which can handle AM, suppressed-carrier AM, SSB, narrow-band FM, phase modulation and continuous-wave (CW) transmissions.

SYNCHRONOUS Detection receiver uses new technique which gives conventional amplitude modulation (AM) many of the advantages of single sideband (SSB) in HF band.

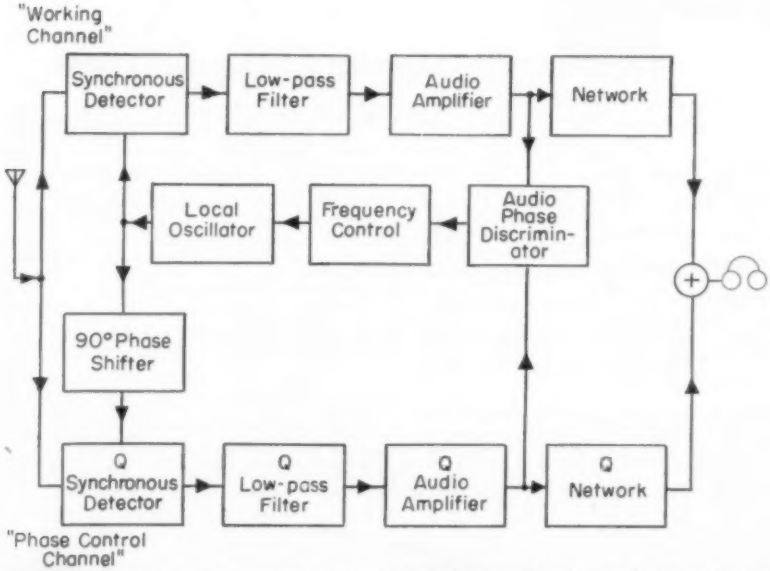
Resists Jamming

When used with a simple suppressed-carrier AM transmitter, a synchronous detection receiver has important military advantages over SSB, Costas believes, because it can compensate for Doppler shift problems and is far less vulnerable to enemy jamming.

Two familiar shortcomings of conventional AM long-distance HF communications are eliminated or greatly eased by the use of synchronous detection, without any change in the conventional AM transmitter. One is selective fading caused by attenuation or loss of the carrier and the other is distortion due to phase/amplitude changes in the sidebands resulting from multipath conditions.

If a conventional AM transmitter is modified to fully suppress its carrier, and this carrier power is put into the two remaining sidebands, a synchronous detection receiver can match SSB in signal-to-noise ratio, based on equal average powers at the transmitters, Costas said.

At the present stage of development, a synchronous detection receiver is roughly comparable in size and weight to an equivalent SSB receiver, Costas said. However, potentially a synchronous detection receiver could be made somewhat smaller, lighter, and less complex than its SSB equivalent, Costas believes. Synchronous detection has, so far, gotten only a small fraction of the development funds and effort that have gone into SSB, Costas points out.



SYNCHRONOUS detection receiver has dual channels—one for audio and the other for phase control.

Selective Fading

An undesirable characteristic of long-distance HF communications under certain atmospheric conditions is the attenuation of a narrow band of frequencies—called selective fading. If the attenuated frequencies correspond to the transmitted carrier frequency, it will be greatly weakened or lost. This causes serious loss of intelligibility in the receiver which needs the carrier for signal detection (demodulation).

The new synchronous detection re-

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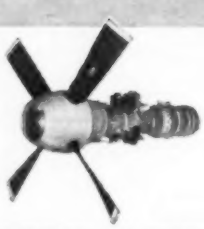

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8) Checks EGT system with engine removed from aircraft (in production line or overhaul shop).
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ceiver, like its SSB counterpart, does not need or use the carrier for detection. Instead the carrier is generated within the receiver by a frequency reference whose stability is comparable to that required for single sideband, Costas said. (When working with a conventional AM transmitter, its carrier is not used.)

By eliminating the need for a transmitter carrier, synchronous detection makes it possible for all transmitter power to go into the two intelligence-carrying sidebands. In single sideband, the power all goes into one sideband. Although this means that a synchronous detection system occupies twice the theoretical bandwidth of an SSB system, Costas believes that there are significant benefits which accrue as a direct result.

If the synchronous detection receiver is to make effective use of the power that goes into the two sidebands, it must be able to add together the separate audio signals produced by the two sidebands. This requires that the phase relationship between the two sidebands and the receiver-generated carrier be identical to that at the transmitter (before the carrier is suppressed).

Phase Control

GE's synchronous detector employs no intermediate frequency conversion. The local oscillator-generated carrier frequency is injected into the detector to produce a demodulated audio output directly. To synchronize the phase of the receiver's local oscillator with that of the transmitter, GE makes use of the fact that a 90 deg. phase shift between the two will cause a null (minimum) in detector audio output.

GE therefore has built two identical channels, both operating from the same input signal, into its synchronous detection receiver. (See block diagram, p. 81.) One channel, which might be termed the working channel, provides the ultimate audio output signal. The other, or control channel, maintains the phase relationship between the local oscillator and the transmitting station's local oscillator.

This is accomplished by shifting the phase of the local oscillator signal by 90 deg. prior to injecting it into the control channel synchronous detector. As long as the desired phase relationship exists, there will be no audio output from the control channel.

However, any loss of synchronism will produce an audio signal in the control channel. The signal's polarity, relative to the audio output of the working channel, will indicate the required direction of phase shift of the local oscillator relative to the transmitter. This polarity comparison is made in the audio phase discriminator which then shifts the local oscil-

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lator back into synchronism.

This phase control function can operate only when one or both sidebands are present. Thus phase lock-up stops when transmitter modulation ceases and must be re-established when it returns. However Costas says that lock-up normally occurs so fast that no perceptible distortion occurs in voice transmission.

He reported that the synchronization works effectively at noise levels so high that voice communication is ineffective.

Diversity Feature

In theory, phase and amplitude variations in one sideband relative to the other caused by multipath conditions in long-range communications—a problem that doesn't exist for single sideband—should adversely affect a synchronous detection receiver working with a double sideband transmitter. However, tests to date indicate that such is not the case and synchronous detection with double sidebands matches SSB performance and occasionally excels it, Costas reported.

For example, on some occasions a serious flutter has been noted in SSB reception which was only slightly discernible in synchronous detection reception of a simultaneous double sideband transmission, Costas said. Although this phenomenon is not fully understood, Costas suspects that the two sidebands are providing a sort of frequency diversity transmission so that selective fading of one sideband does not reduce audio output as theoretically it could do with only a single sideband.

Where phase shift of one sideband relative to the other occurs, Costas says the phase control system appears to adjust the local oscillator phase automatically to an optimum value which minimizes audio distortion.

The problem of Doppler frequency shift in ground-air communications, which arises because of airplane velocity, may raise serious problems for SSB in new supersonic aircraft unless some type of controlled carrier system is used.

However, with two sidebands available, the synchronous detection receiver can easily compensate for Doppler shift, Costas says.

Anti-Jam Feature

The control channel, operating in phase quadrature with the working channel, performs another important function—reduction of interference and jamming. When the receiver is operating (synchronized), the only output signal from the control channel will be interference (white noise) or jamming signals. The working channel will have both the useful audio signal plus the interference signal. By suitable filtering, followed by a subtraction of the control channel output from the working channel output, the effect of interference usually can be greatly reduced, Costas said.

When "intelligent enemy jamming" is encountered, synchronous AM has a two-to-one power advantage over single sideband, Costas says.

In terms of receiver design features, Costas believes that synchronous detection offers interesting new possibilities to the receiver designer:

- **Lack of intermediate** frequency conversion eliminates completely the problem of image responses which plague designers of conventional receivers.
- **Extreme selectivity** can be achieved because of post-detector filtering, and bandwidth can be easily changed with low-pass filter switching.
- **Majority of receiver gain** is achieved at audio frequency. This allows low-pass filter to be inserted at low signal levels, protecting against spurious responses to very strong adjacent channel signals from nearby transmitters. RF circuitry is kept at a minimum, and low-cost audio-frequency transistors can be used widely.

Although the synchronous detection techniques are not inherently competitive with SSB, Costas believes that a suppressed-carrier AM system used

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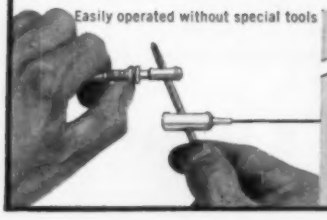

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with a synchronous detection receiver may have several advantages over the highly touted SSB—particularly for military applications where enemy jamming and Doppler shift problems exist.

Costas admits that synchronous communications offer no gain in the available number of channels in the crowded high frequency band, but he suspects that the theoretical 2:1 channel gain of SSB may not be realized in military, mobile and airborne use. Unless SSB equipment is kept in tip-top operating conditions, it may be a single sideband system in name only, Costas fears.

SSB equipment generally is conceded to be more complex than conventional AM, whereas synchronous AM with suppressed carrier can use less complex transmitters and receivers.

Rome Air Development Center has shown sufficient interest in the new technique to sponsor GE's efforts and currently is evaluating several experimental equipments. Meanwhile GE is visiting various military agencies and operating groups to acquaint them with the potentialities of synchronous communications.

Costas believes that AM is far from obsolescence. Its two biggest shortcomings, he believes, are inefficient use of generated power at the transmitter and inefficient detection methods at the receiver. Suppression of the transmitter carrier eliminates the one objection and synchronous detection eliminates the other, Costas says.

To demonstrate the effectiveness of the new technique, GE has made a tape recording of a shortwave broadcast (11.7mc.) from Australia using a receiver that could be switched from conventional AM to synchronous detection or SSB.

Under adverse conditions, where conventional AM produced a barely intelligible signal, synchronous detection provided a significant improvement. When the receiver was switched from synchronous detection to SSB, there was no detectable difference in signal reception or intelligibility.

FILTER CENTER

▶ **Vacuum Tube Airways**—Civil Aeronautics Administration has ordered 446,000 vacuum tubes to keep its airways operating during current fiscal year. Tubes range in price from 22 cents to $1,530. Total cost is approximately $1.5 million. Thirty-nine contractors will share the business.

▶ **Small Screen Charactron**—Stromberg-Carlson is now producing miniaturized versions of the 19-in. Char-

Fairchild Engine Division and Gas Turbine Laboratory present IMPORTANT ENGINEERING OPPORTUNITIES

Fairchild Engine Division is now expanding its engineering staffs in its plant and Gas Turbine Laboratory at Deer Park, Long Island, New York.

Investigate these opportunities:

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For mechanical design of turbojet engines and components, and to conduct preliminary design study investigations on gas turbine engines.

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To work closely with design engineers and to make recommendations as a result of analytical studies, with respect to stress analysis of lightweight rotating machinery, vibration, analysis, cycle analysis investigations, analysis of mechanical component functionings and general structural problems.

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Please Contact Felix Gardner

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. . . in Greek means *weapons systems;* and, with the catapult, the Greeks developed one of the earliest weapons systems. Perfected slowly, it reached the height of its effectiveness during the Middle Ages. Today's weapons systems concepts are tremendously more complex than the ancient catapult. The swift advances of science enables only the highly integrated engineering teams to keep pace with the changes. Combined with a perceptive management policy, such a team in a relatively short time can achieve a goal that once took centuries.

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BELL Aircraft CORPORATION

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actron cathode ray tube used in the air defense SAGE system. The new 7-in. diameter Charactron, Type C7C11, has a 4½-in. square display area, can reproduce 1.2 million letters or numbers per minute, and is suitable for high-speed photograph recording. Stromberg-Carlson, which took over the Charactron project from Convair, another General Dynamics division, recently shipped the first airborne avionics equipment produced at its new San Diego operation. The equipment is an amplifier for a stability augmentation system.

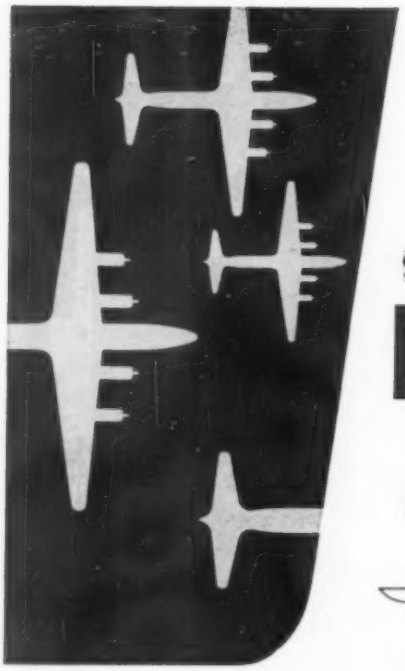
► **Diode Order**—An order for 1 million germanium diodes, placed by Logistics Research Inc., datamation equipment maker, with Hughes Aircraft Co. is called the "largest single diode order on record."

► **British Doppler Navigator**—British Marconi reports that it is producing an airborne Doppler auto-navigator for British and Commonwealth governments and has been in production for more than two years. From limited information released, the Marconi Type AD 2000 auto-navigator appears similar to those developed in the U. S. by such companies as General Electric, General Precision Laboratory, and Ryan Aeronautical.

► **Central Station Computer**—Miniaturized all-transistor airborne digital computer, aimed at performing many of the instrumentation-navigation-fire control computations required in a fighter plane, will soon be delivered by Philco to Naval Air Development Center, Johnsonville, Pa., for evaluation. Developed under Navy BuAer sponsorship, the new Philco "Transac" operates in "real time," employs direct-coupled circuitry which uses transistors and resistors almost exclusively.

► **Blast Through ECM**—General Electric has developed a new 1 kw. UHF transmitter amplifier 10 times as powerful as those now used for ground-air communications, which should make Air Force communications less vulnerable to enemy jamming. Developed by GE's Heavy Military Electronic Equipment Dept., under Rome Air Development Center sponsorship, the amplifier modulator reportedly has less than ⅓ of 1% modulation—qualifying it for a possible future in the High Fidelity marketplace.

► **Omission**—The narrow-bandwidth radar remoting system mentioned in the August 27 article on Northrop Skyscreen (p. 72) is the RAFAX system, manufactured by Haller, Raymond and Brown, Inc.



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gaging of fuel weight on board

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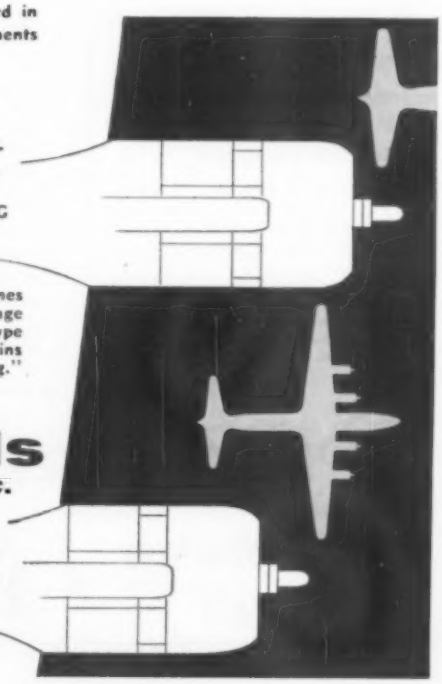

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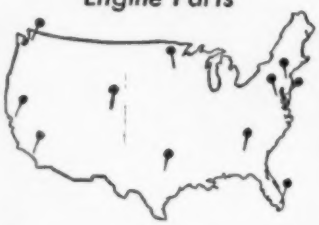

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Expansions, Changes In Avionics Industry

General Electric will headquarter its newly formed Technical Military Planning Operation (TEMPO) at Santa Barbara, Calif. The group, headed by Dr. Richard C. Raymond, will do long-range technical planning and study work for GE's Defense Electronics Division and its five departments as well as taking on outside projects beyond the scope of any one department. TEMPO is temporarily housed at 312 North Milpas St., but plans to build a new facility.

Other recently announced expansions, changes and mergers in the avionics industry include:

• **Airborne Instruments Laboratory,** Mineola, N. Y., has acquired Mountain Systems, Inc., Thornwood, N. Y. through a stock exchange. The new acquisition, which will be operated as a separate and wholly-owned affiliate, is engaged in the data processing field.

• **Hoover Electronics Co.,** Baltimore, has purchased Radio Frequency Antenna Consultants, College Park, Md., which has been renamed the Hoover Microwave Co. The new acquisition will remain at its present location and will expand its work in microwave components. Werner Koppl and William H. Clark, partners and senior engineers in the new acquisition, have been named vice presidents of research and engineering, respectively.

• **Color Television, Inc.,** has moved from San Carlos, Calif. to a new 30,000 sq. ft. facility at 1421 Old County Rd., Belmont, Calif., tripling its former space. Company, which makes automatic test equipment and special purpose testers, expects a four-fold increase in sales in next 18 months to reach $5 million annually, with a three-fold increase in employment.

• **Mandrel Industries, Inc.** is name of a new combine of three firms, which become divisions of the new company. They include: Greenleaf Manufacturing Division (maker of gyros and avionic components;) Electric Sorting Machine Division, and Electro-Technical Laboratories Division, maker of geophysical oil exploration equipment. Greenleaf remains at its present St. Louis location under its present management. James R. Lowe is chairman of Mandrel's Board and James F. Coonan is vice-chairman and managing director. George Quist, Louis W. Greenblatt and A. G. Curtiss complete the Board.

• **AirTropics, Inc.,** Cortez, Colo., will open a new manufacturing facility at Safford, Ariz. New facility is expected to ultimately employ 200.

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The right people
with the right facilities
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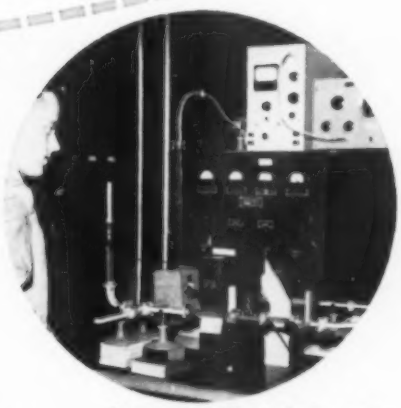
The new Sylvania Microwave Physics Laboratory, Mountain View, California.

Results of gaseous electronics investigation concerned with wide-band tunable microwave oscillations are examined at the Microwave Physics Laboratory. From left: Laboratory Manager, O. T. Fundingsland; Dr. R. M. Hill, senior project leader, gaseous electronics; Dr. P. H. Vartanian, senior project leader, ferrites; and Dr. A. L. Aden, assistant laboratory manager.



Frequency doubling in ferrites, a phenomenon newly discovered at Sylvania Mountain View laboratories, is studied by engineer A. L. Helgesson.

More problem-solving power...

Sylvania's new Microwave Physics Laboratory

NEW PROBLEM-SOLVING POWER has been added to Sylvania's growing capability for research and development in highly advanced military and industrial electronic systems.

With the establishment of the Microwave Physics Laboratory at Mountain View, Calif., Sylvania is expanding its work in new magnetic materials and ionized gaseous media for microwave electronic control devices and systems for radar, communications, and electronic countermeasures.

Fields of research at the laboratory include magnetic ferrites, gaseous electronics, radio wave propagation, electromagnetic resonance phenomena in ferrites and ionized gaseous media.

Besides the new Microwave Physics Laboratory, the Microwave Tube Laboratory and the Electronic Defense Laboratory are also located at Mountain View. Each is a vital part of Sylvania's Electronic Systems Division.

In addition to the Mountain View laboratories, the Electronic Systems Division has plant and laboratory facilities at Buffalo, New York, and extensive research facilities at Waltham, Massachusetts. All are staffed with top-ranking scientists and engineers, backed by Sylvania's extensive resources in the electronics field.

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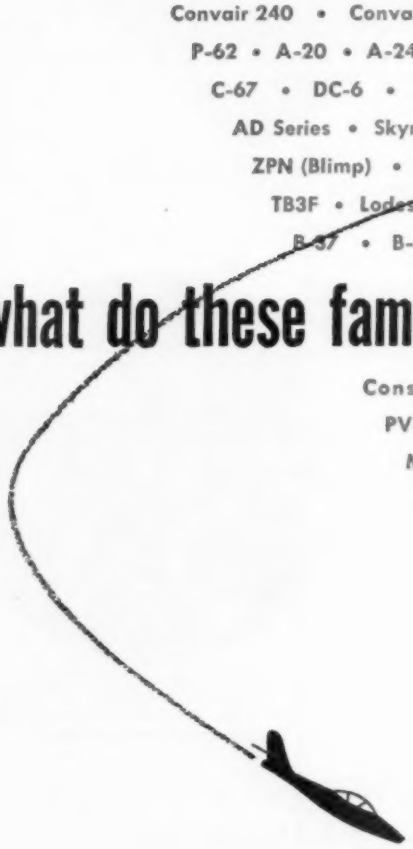
ZPN (Blimp) • AF2W • ZP2K (Blimp) • ZP5K (Blimp) • F4F • TBF-6
TB3F • Lodestar • H-23 (Helicopter) • A-28 • A-29 • AT-18 • B-34
B-37 • B-38 • C-36 • C-37 • C-63 • Constellation "049"

what do these famous aircraft have in common?



Constellation "749" • Super Constellation "1049"
PV-1 • PV-2 • P2V Series • XR-60-1 • B-26
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Martin 404 • AJ-1 • B-25 • P-51 • T-28
C-125 • P-61 • Apache • XF-12
Rainbow • P-47 • Seabee • Fireball
HSL (Helicopter) • Navion • PT-22
Courier (Helicopter) • Learstar • Super
Constellation "1049 G" • HUP-4
(Helicopter) • PT-25 • H-21
(Helicopter) • XT-37 • H-19
(Helicopter) • T-35 • F-84F
• YC-130 • XP5Y
C-130A • XV-3 (Heli-
copter) • T-37 • XFV
Super Navion
S2F • R3Y
• RF-84F

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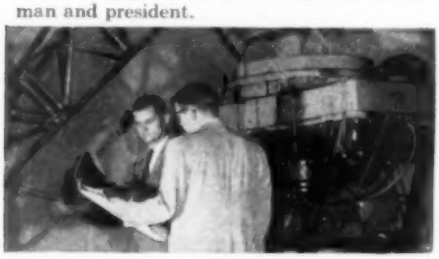

The award was for a lightweight, transportable radar antenna invented by Mr. Miller.

Coleman Miller—A Career Engineer—
Wins $8,000 in Awards...
At Electronics Division

A career engineer can cash in on his creativity at Westinghouse in Baltimore. Coleman J. Miller, an advisory engineer, has already received checks for $5,000 and $3,000 in patent awards from the company.

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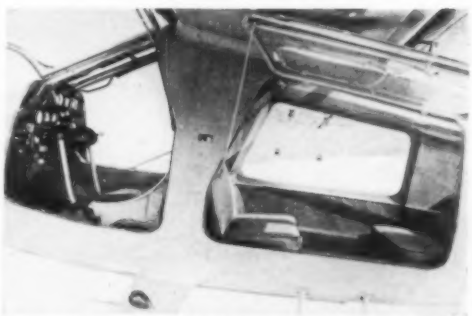
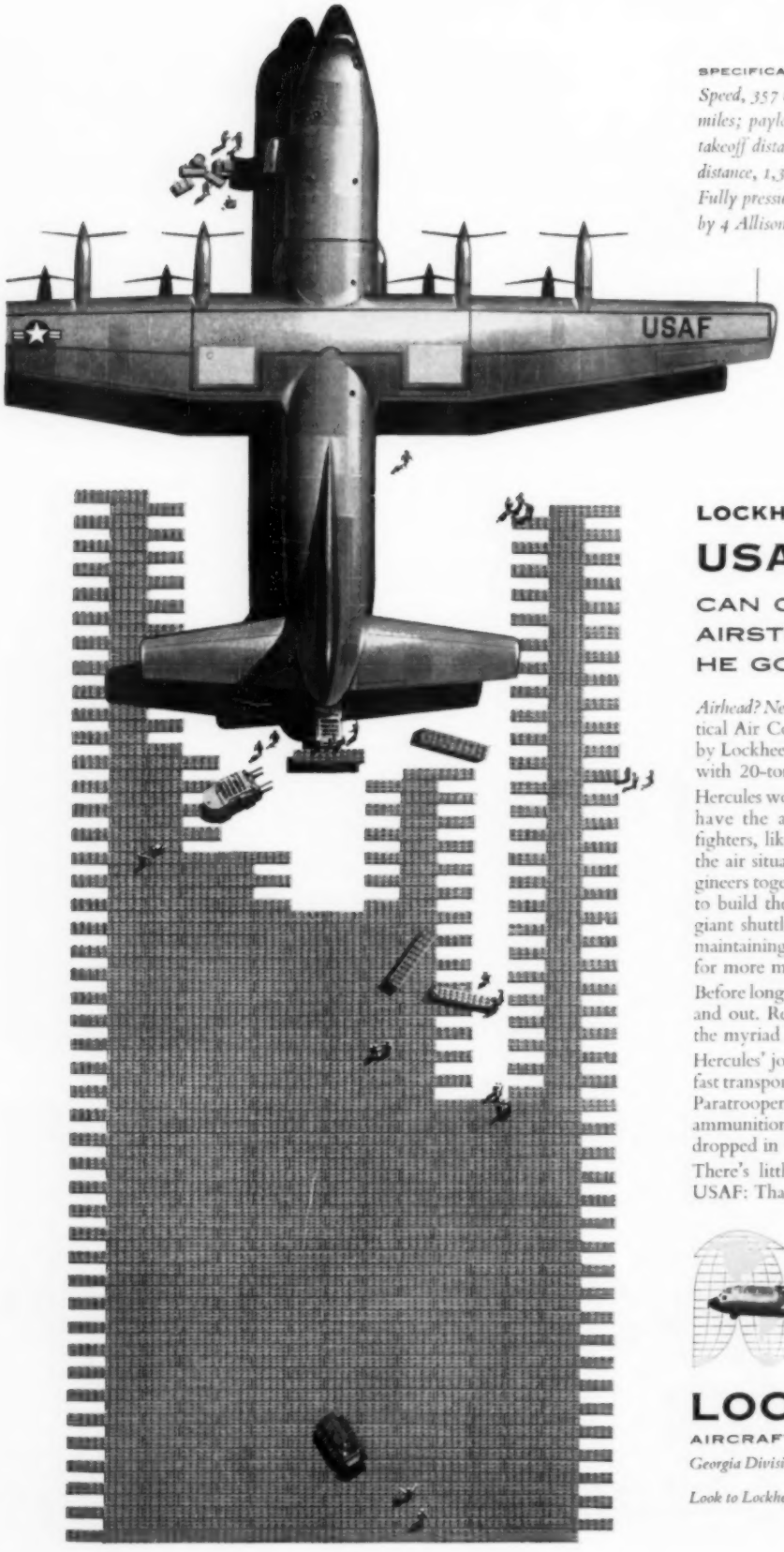
BUSINESS FLYING

Edgar Percival E.P.9 agricultural plane carries one ton, costs about $25,000. Planned 1957 production is 150.

Auster Agricola hauls 1,500 lb. of fertilizer. Designed for New Zealand operations, 15 are being built.



Dornier DO-27 STOL multi-purpose plane takes 295 ft. for takeoff, lands in 82 ft. Initial production is going to German army, civilian models will be available in 1957. Army version has a 270-hp. Lycoming. Later version will have a 225-hp. Continental engine.



SPECIFICATIONS:
Speed, 357 mph; range, 2,500 nautical miles; payload, 25,800 pounds; takeoff distance, 2,000 feet; landing distance, 1,320 feet. Fully pressurized. Powered by 4 Allison propjets.

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Look to Lockheed for Leadership

New Floatplane Models Make Debut

Latest version of the 14-place de Havilland-Canada Otter (above) is fitted with amphibious float gear having hydraulically retractable wheels. With the new floats the Otter can operate at 8,000-lb. gross weight. Floats are basic Edo gear modified in Canada by MacDonald Bros., subsidiary of Bristol Aeroplane Co. Taylorcraft Seabird (below) recently certificated for Edo 249-2870 floats is approved at 3,040 lb. Feature of the Seabird is a steel-tube fuselage covered with molded fibrous-glass plastic resin coated skin. Seabird cruises at 130 mph.

PRIVATE LINES

Price of Cruisemaster four-place business plane being built by Northern Aircraft, Inc., Alexandria, Minn., is $15,792. Former Bellanca airplane design, manufacturing and sales rights, tools, fixtures, dies and jigs are now owned by Northern Aircraft, which schedules an initial production of one plane weekly. Northern Aircraft Cruisemaster is powered by a 230-hp. Continental, has a top speed of 220 mph., cruise speed of 205 at 75% power, rate of climb of 1,250 fpm. and range of 1,000 mi. Original manufacturer, Bellanca Aircraft Corp., built 99 Cruisemasters until Korean War halted production.

Esso plans to have flush-mounted Aerojet Jato emergency power units installed on two DC-3 executive planes. The company now has external Jatos on one of the airplanes.

Ontario Hydro-Electric Power Commission received a license from Canadian Air Transport Board to operate a helicopter to patrol transmission lines, oil or gas pipelines and transport persons and cargo for the commission and other government departments.

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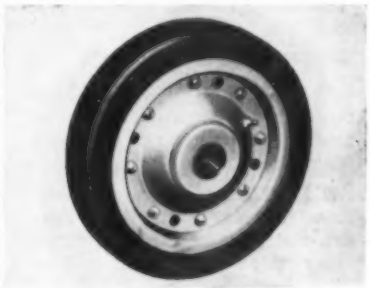

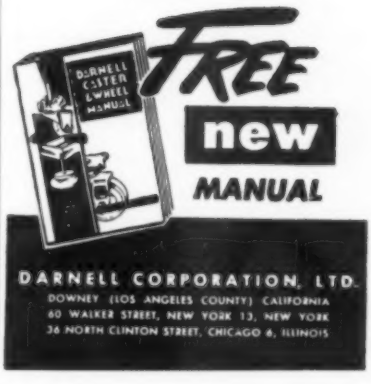

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Write: Professional Staff Appointments

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8615 Georgia Avenue, Silver Spring, Md.

WHO'S WHERE

(*Continued from page 23*)

Changes

Brian Sparks, general manager, Clary Corporation's Aircraft Division, San Gabriel, Calif. Mr. Sparks will continue as chief engineer.

A. R. Ogston, technical consultant, Esso Export Corp., Aviation Department, New York, N. Y. Also: **E. O. Petzold**, Technical Service Division head, and **J. P. Acton**, Field Service Division head, Export's Aviation Department.

William B. Haylon, manager-public relations, McDonnell Aircraft Corp., St. Louis, Mo.

Edwin D. Maxfield, commercial division manager, Aviation Department, Shell Oil Co., New York, N. Y.

Robert K. Barrett, director-management engineering, Trans World Airlines.

Robert E. Wolin, district manager-Wichita, Kan., Learcal Division, Lear, Inc., Santa Monica, Calif.

Richard P. Frazee, office manager, **George T. Correll**, manager-contracts, and **J. Donald Haas**, applications engineer, Washington Office, Reaction Motors, Inc., Denville, N. J.

Leonard P. Cornwall, cargo sales manager (U.S.), Pan American World Airways.

Richard P. Thornton, marketing manager-aircraft and guided missiles, Amphenol Electronics Corp., Chicago, Ill.

R. D. Rumsey, chief engineer-aircraft, Buffalo Hydraulics Division, Houdaille Industries, Inc., Buffalo, N. Y.

C. M. Doolittle, manager for Braniff Airways in Argentina, Uruguay, Paraguay and Chile.

H. T. Dietrich, assistant to the president, is now Washington, D. C. representative, Kaman Aircraft Corp., Bloomfield, Conn.

Francis Cummings, Electro-Mechanical Products Development Section head, Microloc Corp., Los Angeles, Calif.

Ray E. Horner, manager-data processing and scheduling, General Electric's Light Military Electronics Equipment Dept., Utica, N. Y. Also: **George R. Harris**, manager-sales.

Bruce H. Atwater, sales manager, Pastushin Aviation Corp., Los Angeles, Calif.

Ray Silvius, news bureau manager, Western Air Lines, Inc.

John F. Burridge, assistant sales manager, Hamilton Standard, division of United Aircraft Corp., Windsor Locks, Conn. Also: **Alfred B. Thacher** replaces Mr. Burridge as Dayton representative, and **Morgan Jones** replaces Mr. Thacher as chief sales engineer (propellers).

William G. Mays, director-sales and service, Meletron Corp., Los Angeles, Calif.

Frank L. Kelsey, manager of newly established Indianapolis, Ind. district office of Niagara Machine and Tool Works, Buffalo, N. Y.

Neil B. Berboth, assistant to general manager, Flying Tiger Line, Inc.

W. R. Perry, manager of newly opened Pasadena, Calif. office of Clark-Aiken Co., Lee, Mass.

William M. Myers, manager, Atlanta, Ga., branch of Air Associates, Inc.

William G. Webster, chief engineer-Cleveland Division, Parker Aircraft Co., Los Angeles, Calif.

Al Heinsohn, Sales Department, Safe Flight Instrument Co., White Plains, N. Y.

Robert S. Bubb, manager-commercial development, ACF Industries, Inc., St. Charles, Mo.

G. Z. Zimmerman, manager-airlines and distributors, and **Charles H. Kanavel**, field sales manager, Aviation Products division, B. F. Goodrich Co., Akron, Ohio.

B. J. McNamara, executive assistant to the general manager, Pratt & Whitney Aircraft, East Hartford, Conn. Mr. McNamara succeeds **Charles T. Roelke** now general manager of the company's Florida operations. Also: **Earl E. Champion** succeeds Mr. McNamara as purchasing manager.

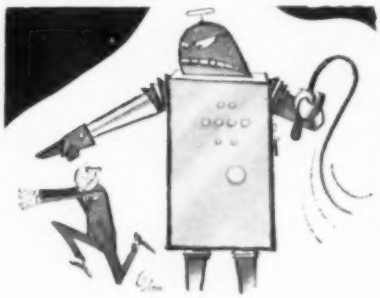
Willy A. Fiedler, assigned to a research and development post—engineering's Advanced Design Division, Lockheed Missile Systems Division, San Jose, Calif.

P. E. Laliberte, sales manager-weapon control equipment, General Electric's Light Military Electronic Equipment Dept., Utica, N. Y.

Louis J. Alvare, director-engineering, and **George Hand**, director-product research, Technitrol Engineering Co., Philadelphia, Pa. Also: **Gerard J. Bradley**, director-contract manufacturing, and **Robert K. Brewer**, director-product manufacturing.

Guy Miller, manager-Model 620 Sales Department, Cessna Aircraft Co., Wichita, Kan.

John Farley, director, newly formed Marketing Department, Greer Hydraulics, Inc., Jamaica, N. Y.



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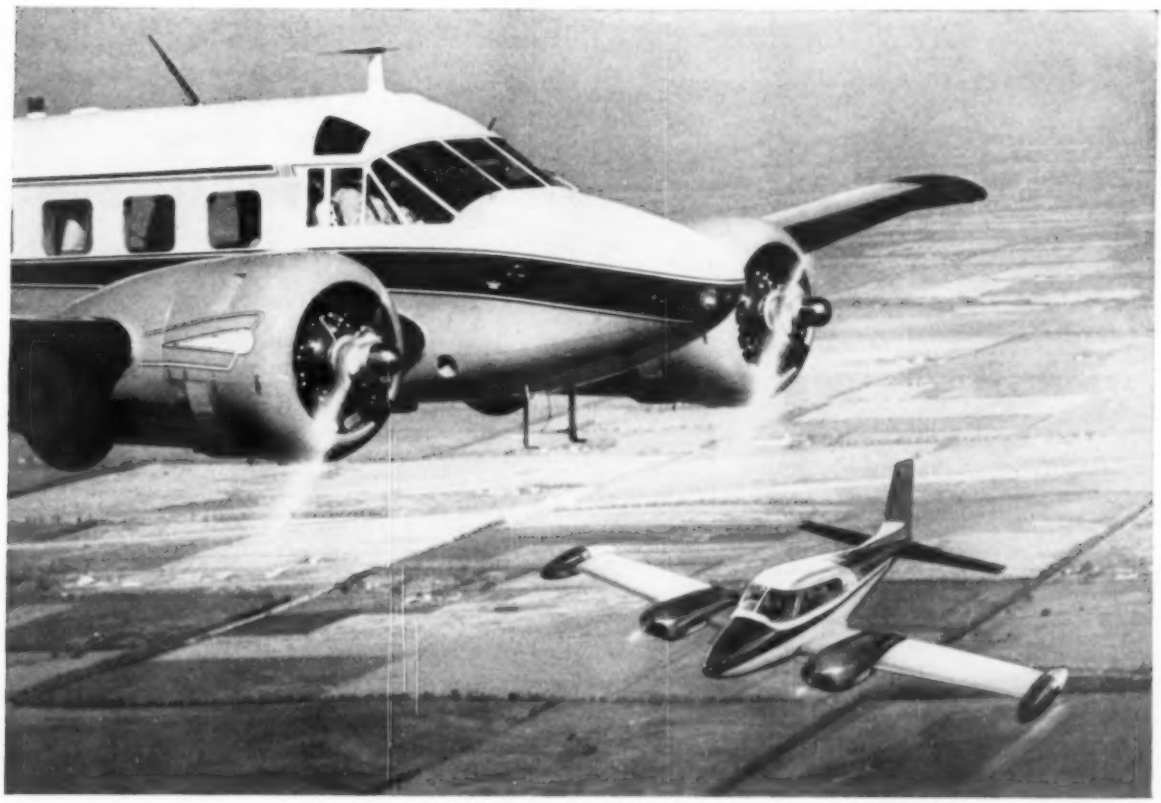

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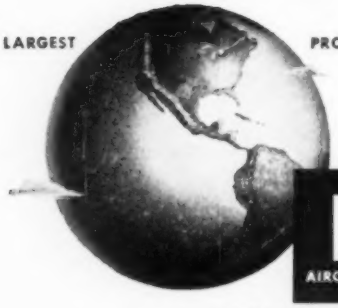

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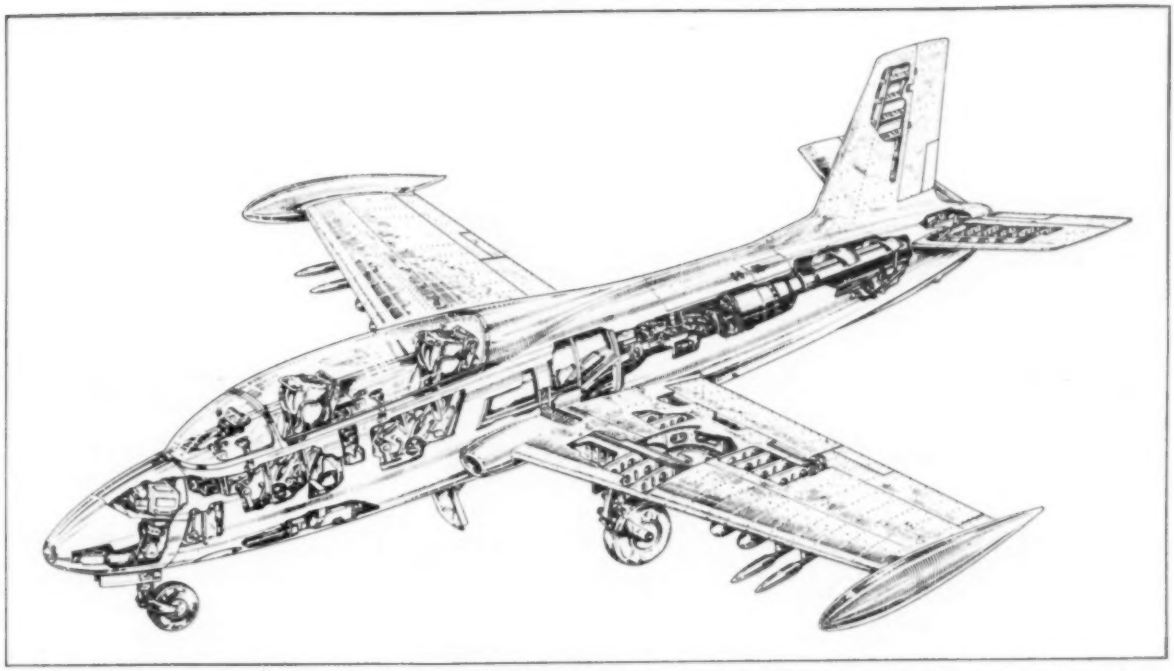


ARMED with bombs, machine guns and rockets, Macchi M.B. 326A version carries student through combat and attack training curricula.

Macchi Builds Versatile Jet Trainer

Prototype of a new light jet trainer designed to perform primary and basic missions is being built for the Italian Air Force by Aeronautica Macchi, Varese, Italy. The company also has advanced versions planned capable of carrying out combat and ground attack training.

The Macchi M. B. 326 two-place tandem trainer is being fitted with cabin pressurization to permit high-altitude navigation training at 26,000-29,500 ft. and is designed to familiarize students with compressibility phenomena, having a Mach 0.8 speed limit. Starting a 40-deg. dive at 310 mph. at 29,500 ft. brings the M.B. 326 to its critical Mach number at 23,000 ft. and its Mach limit at approximately 19,500 ft.

Design Speed

When fitted with two .30-cal. machine guns and varying loads of rockets and bombs, the airplane is designated M.B. 326A. This model has a design top speed of 404 mph. at sea level at a gross weight of 5,953 lb., 220 lb. less than the M.B. 326.

The planes are designed around the 1,750-lb.-thrust Armstrong Siddeley ASV.8 Viper axial-flow turbojet; a later version will have a 2,200-lb.-thrust engine.

A trapezoidal wing plan, tapered in plan and thickness is used. Leading edge is swept 11 deg. 18 min., trailing edge is straight. Airfoil is of the NACA 6 A laminar-flow series. Wing mean chord is 6.233 ft., aspect ratio is 5.26 and taper ratio is 1.71. Gross wing area is 204.5 sq. ft.

Wing structure is basically of single-spar type with the center section built integral with the fuselage. Ribs are closely spaced with no spanwise stiffeners.

MACCHI M. B. 326

Specifications

Span	32.8 ft.
Length	33.7 ft.
Gross weight	5,953 lb.*
Empty weight	3,804 lb.
Top speed at sea level	404 mph.*
Top speed at 29,500 ft.	449 mph.*
Minimum speed, flaps down	82 mph.*
Rate of climb, sea level	3,051 fpm.*
Range, with drop tanks at 29,500	715 mi.*
Ground run to clear 50-ft. obstacle	2,165 ft.*
Landing run over 50-ft. obstacle	2,165 ft.*

* Figures relate to M.B. 326A, armed version of M.B. 326. Macchi notes that performance of latter is higher due to it having a gross weight 220 lb. less than M.B. 326.

Fuselage is a monocoque structure comprising sheet-formed bulkheads and four main longerons. Horizontal tail consists of a two-spar stabilizer with single-spar elevator, the latter statically balanced and fitted with servo and trim tabs. Vertical tail is of similar construction.

Tip Tanks

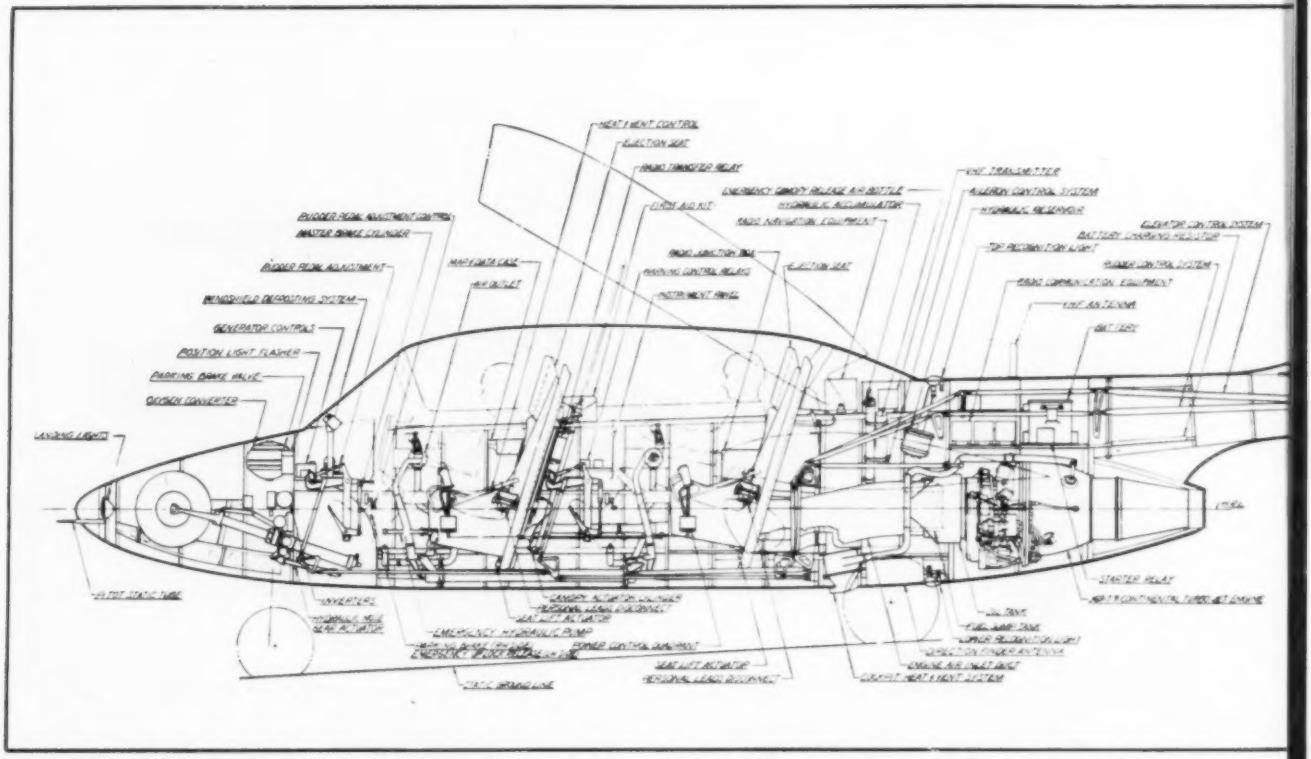
Fuel system totals 228 U. S. gallons carried in a two-compartment flexible cell behind the cockpit and above the engine intake. Auxiliary jettisonable wing-tip tanks, each carrying 42 U.S. gallons supply the main tanks by means of compressed air tapped from the powerplant.

High-pressure, high-temperature air is supplied to the cockpit from a heat exchanger and provides sea level atmosphere from zero to 9,800 ft., the equivalent of 9,800-ft. altitude from that height to 20,500 ft. and a pressure differential of 3.55 lb./sq. ft. above 20,500 ft.

The cockpit canopy is sealed by inflatable tubing expanded by bleed air from the engine compressor.

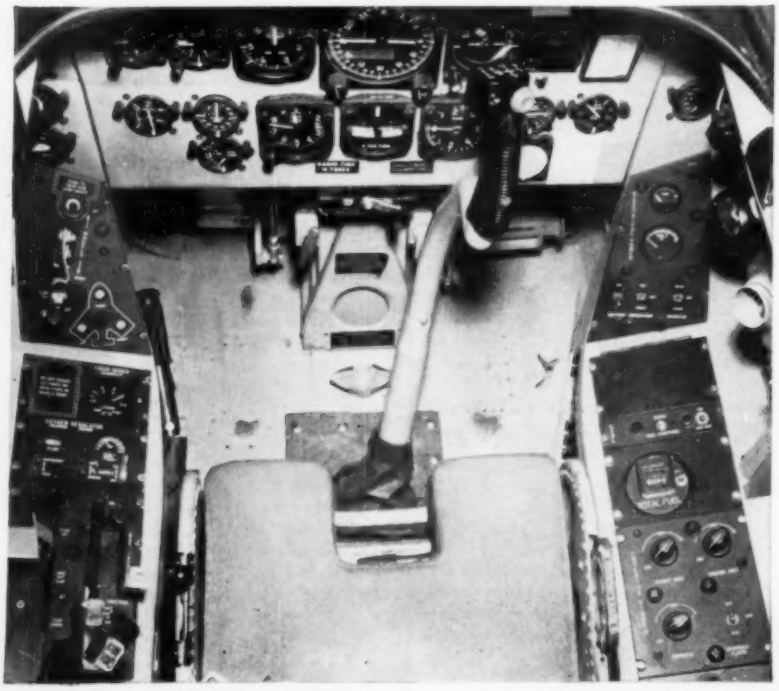
The M.B. 326 uses a hydraulic system to operate landing gear, wing flaps, underbelly dive brake, wheel brakes and cocking of the .30-cal. machine guns.

Electric system comprises two 24-v. 35 amp./hr. accumulators connected in parallel.



POD-AND-BOOM FUSELAGE is planned to allow installation of more powerful engines when available; to ease such changeover, powerplant

Temco Achieves Simplicity, Economy in



TT-1 COCKPIT has simplified instrument layout. Rudder pedals are adjusted by a crank.

By Erwin J. Bulban

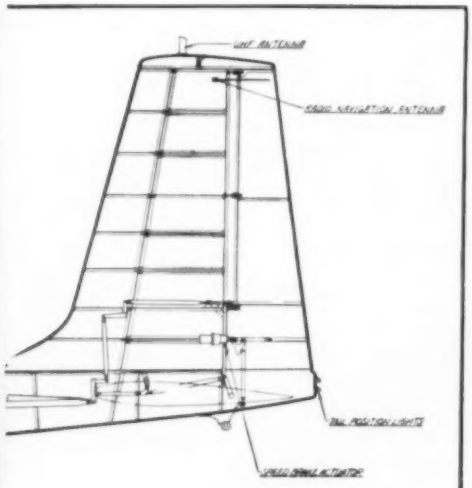
Dallas—Temco TT-1 jet primary trainer for the U. S. Navy combines construction simplicity, light weight and low cost with a wide speed range that permits students to be checked out at speeds up to Mach .75.

It was developed and built entirely with Temco Aircraft Corp. funds. Initial production airplane of a contract for 14 is scheduled to be delivered next July, and an indication of the airplane's production economy is the contract's dollar volume: approximately $2 million.

The basic design of the Temco TT-1 aimed at reproducing as faithfully and feasibly as possible cockpit layout common to single-place jet fighters—hence the tandem seating arrangement. This viewpoint differs from USAF, which has gone to the side-by-side seating philosophy as in the Cessna T-37A.

Cockpit Layout

Cockpit equipment closely follows the pattern of combat-type aircraft including ejection seats, a liquid oxygen system, edge-lighted check list



area does not comprise the primary structure.

Jet Trainer

on the panel, speed brakes and trim-tab switches on the control sticks.

Instructor and student are placed well ahead of the wings, providing the instructor with excellent visibility for monitoring the air and giving him a good view in event he has to take over the controls on landing or takeoff or in flying in congested traffic patterns.

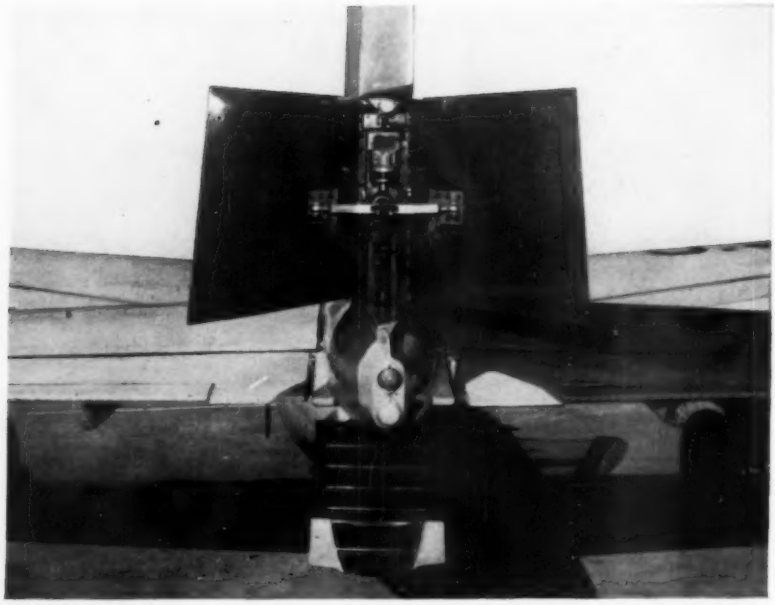
Cockpits have a "hot mike" intercom providing continuous monitoring. The instructor may override all interphone or radio communication equipment at will. Controls are operated by push-pull mechanical linkages.

Spring tabs are fitted to the ailerons to reduce hinge moments and electrically operated trim tabs are provided on elevators and left aileron. Electrical override features allow the instructor to take over operation of the trim tabs and the tail mounted speed brake at will. A spring-loaded switch on right side of the cockpit permits seats to be adjusted up and down over a range of 4½ in.

The clear-bubble cockpit canopy is manually operated. To save weight and reduce complexity, Temco engineers utilize the lower tube of the canopy arm as an air cylinder, the upper tele-

ACCESS TO ENGINE (above) is obtained by removing two pieces of cowling (below) fitted with quick-remove latches.

SUPPORT ITEMS for maintenance include engine dolly that serves as work stand and hoist.



DIVE BRAKE splits open in three sections, beneath the rudder and under the tail cone.

scoping connecting link as a piston. The cylinder section can be adjusted via an air bleed-off to give any desired tension. There is a roller-type locking mechanism at the front of the canopy utilizing pins sliding out of the canopy into receivers on the windshield section.

Another neat design trick is an interconnection to the retractable steps on the fuselage side so that they automatically pop open when the canopy is opened, are retracted by the canopy's closing.

The three-piece speed brake has panels opening outward below the rudder and a panel opening downward beneath the tail boom. Direct mechanical linkage is provided to the three segments by means of a hydraulic actuator tied to a bell crank.

Electrical power is provided by a 28-v. system with a 24-v. 22-amp./hr. nickel-cadmium battery located above the engine section, starting the engine without need for external power sources. The battery also acts as a standby in event of starter-generator failure. A universal receptacle is provided for plug-in external starting source.

Flight Characteristics

TT-1 project engineer Doyle Brooks selected low-drag NACA 64_2A118 and 64_2A415 airfoil series having sufficient thickness to provide good low-speed characteristics. The TT-1 stalls at 63 kt. with gear and flaps down at its normal landing weight of 3,776 lb., dropping its nose in the stall, avoiding any tendency to go off on the wings. Controls are effective into the stall. The rudder stays effective at least 15 mph. below the stall, Brooks said.

Takeoff is made at approximately 75 and 80 kt. and approach speed is between 70 and 75 kt. Landings can be shot with the speed brakes open, allowing high engine rpm. to maintained in the event of a forced go-around.

The TT-1 is unrestricted for aerobatics, the airframe being designed for an ultimate load factor of 11.25 Gs. Limiting Mach number of .75 allows exploration of high-speed characteristics in the training schedule. Precision spins are possible; the airplane will work out of a spin by releasing the controls.

Fuselage Layout

Two floor beams, approximately 16-in. apart, made up of aluminum sheet webs and caps, form a rugged belly keel. Loads on the tail are transferred along the full monocoque tail boom, dump onto the upper fuselage longerons and through the skin panels to the lower longers and the floor beams.

This technique leaves the engine area non-structural permitting installation of later, more powerful engines when they become available without disturbing the primary fuselage structure.

Just aft of the cockpit is a solid bulkhead having a heavy web to which is bolted the center wing section. Another solid bulkhead at Station 68 takes the nose gear loads.

Ease of maintenance was planned by putting 25 access doors on the airplane, not counting wheel wells. Production airplanes will have the entire

Temco TT-1 Trainer Specifications

Powerplant	1 Continental YJ69-T-9
Thrust	920 lb.
Gross weight	4,400 lb.
Normal landing weight	3,776 lb.
Empty weight	3,139 lb.
Wing span	29 83 ft.
Length	30.1 ft.
Height	10.83 ft.
Total wing area	150 sq. ft.
Aileron area	10.04 sq. ft.
Flap area	15.65 sq. ft.
Aileron trim tab area	0.45 sq. ft.
Aileron spring tab area	1.5 sq. ft.
Aileron travel	±17.5 deg.
Aileron trim tab travel	±10 deg.
Aileron spring tab travel	±6 deg.
Flap travel	40 deg.
Wing root airfoil	NACA 64_2 A118
Tip airfoil	NACA 64_2 A415
Root incidence	+4 deg.
Tip incidence	−1.5 deg.
Dihedral	6 deg.
Total vertical tail area	23.5 sq. ft.
Fin area	18.4 sq. ft.
Dorsal area	0.74 sq. ft.
Rudder area	5.1 sq. ft.
Rudder tab area	0.875 sq. ft.
Speed brake area	4 sq. ft.
Total horizontal tail area	39.03 sq. ft.
Stabilizer area	26.6 sq. ft.
Total elevator area	11.6 sq. ft.
Elevator tab area	0.83 sq. ft.
Elevator balance area	0.8 sq. ft.
Stabilizer incidence	+1 deg.
Rudder travel	17 deg.
Elevator travel	+25 deg., −10 deg.
Elevator tab travel	+8 deg., −28 deg.
Speed brake travel	40 deg.
Maximum speed @ 4,078 lb. @ sea level	285 kt.
Cruise speed	235 kt.
Maximum dive speed	450 kt.
Landing approach speed	70–75 kt.
Stall speed, power off, gear and flaps down @ 3,776 lb.	63 kt.
Rate of climb @ 4,078 lb. @ sea level	1,900 fpm.
Service ceiling	32,000 ft.
Cruise ceiling (initial)	20,900 ft.
Cruise ceiling (final)	23,800 ft.
Takeoff distance, zero wind @ 4,400 lb. @ sea level over 50 ft. obstacle	3,250 ft.
Landing distance, zero wind @ 3,776 lb. @ sea level over 50-ft. obstacle	1,790 ft.
Maximum range	240 naut. mi.
Endurance	1.5 hr.
Fuel capacity	124 gal.

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belly made up of removable panels to allow complete access to the hydraulics and control systems.

Wings basically comprise a main spar at 30% chord made up of web and extruded caps riveted and of constant section. The rear spar is of similar makeup but it tapers. Honeycomb hexagon aluminum-core panels are used between the spars along the entire wing on upper portion, from the wheel wells outward underneath. Honeycomb material is also used for leading edges in wing center sections and the wheel doors. Molded reinforced plastic is also widely used on the TT-1: wingtips, stabilizer tips, tail cone and the engine intakes.

Fuel system, totaling 124 gal., is carried in rubber cells in the leading edge of the wing center section and in three cells between the spars in the outer wings. Production model may have two cells in the outer wings, Brooks stated. The TT-1 will be able to make approximately 15 touch-and-go landings during one flight. Endurance is estimated at 1½ hr.

Landing gear is designed for sink rate of 20 fps., rugged enough to permit carrier operations, according to Temco. The main gear strut hooks between the spars on two hangars made up of heavy forgings, one hangar on the main spar, the other on a false spar ahead of the rear spar.

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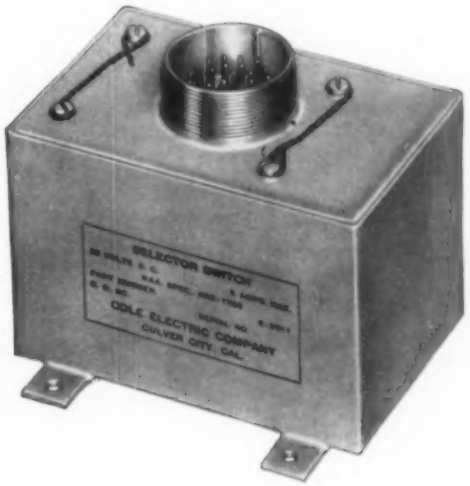

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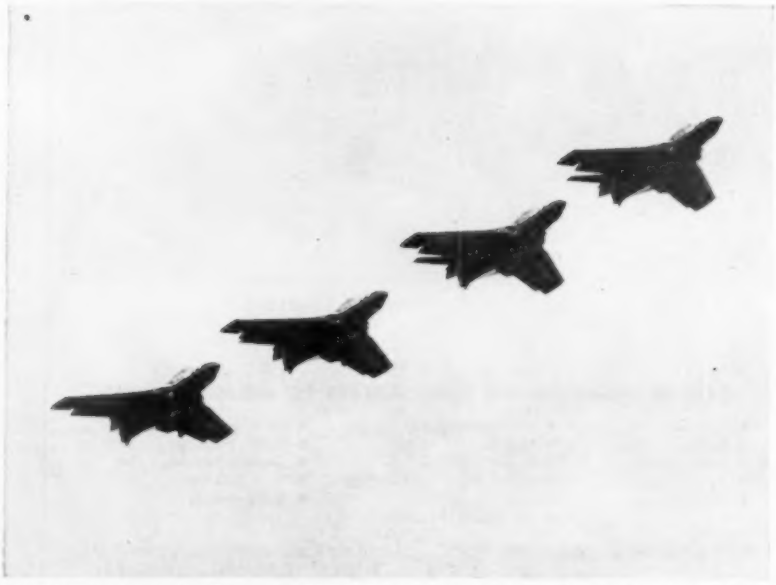

NAVY Blue Angels in Grumman F9F-8 Cougars in close formation with wheels down.

USAF Thunderbirds in North American F-100Cs fly past at National Aircraft Show.

COLORED vapor trails from Blue Angels' wingtips as close formation climbs.

A great step forward in the automation of fuel systems

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IATA Technical Committee Report:

Advent of Jets Dominates IATA Planning

ANSELME VERNIEUWE, Sabena, committee chairman.

CAPT. J. W. G. JAMES, B.E.A., vice chairman.

RAYMOND DUPRE, Air France, chairman, at Boeing 707 controls.

(Because of the importance of the jet transport problems, Aviation Week is printing the full text of the IATA Technical Committee report, signed by Anselme Vernieuwe, delivered at the 12th general meeting at Edinburgh. This is the first part. The second will appear next week.)

As acting chairman of your Technical Committee, it is my duty to report to you on the technical activities we have pursued during the past year. Under normal circumstances this would be an occasion on which I would inform you of the pleasure it is for me to be with you, and, while I do indeed feel honored, I am, like all my technical colleagues, saddened by the great loss we have suffered with the passing of our chairman, André Priester, during the Technical Committee's 21st meeting last November in Paris.

Much has already been said on the subject of Mr. Priester's contribution to the development of civil aviation and there is little more I can add. However, it may not be too widely known outside purely technical circles that, for the last few years of his life, André Priester devoted all his energy to preparation for the coming jet age. He inspired us all with his enthusiasm and confidence and, in the substantial amount of work we still have to undertake in planning for the large scale introduction of turbine powered aircraft, the spirit of André Priester will always be with us.

So far as the statistics of our technical activities are concerned, I can inform you that the number of occasions on which your technical experts met to study both regional and world-wide problems was 49, representing a large increase over the meetings held in the previous 12 months. These statistical data are an indication of the extreme pressure under which many people in the airlines' technical field have been forced to work during the past year, often on behalf of the industry as a whole in addition to their normal airline duties. The mere number of meetings is by itself no direct measure of our achievements, but it is my sincere belief that the standard of the work performed and reported on in detail later in my report has been most encouraging.

Although not always reflected in the titles of our meetings, it is almost impossible to think of a single technical activity during the past year in which there was not some aspect of future jet operations under consideration.

This is a very natural and desirable state of affairs and one which I am sure will become even more evident over the next year or so. A related aspect of our overall jet operations studies, which was mentioned to you by Mr. Dupré in his report last year, and which is clearly becoming more generally appreciated with the passage of time, is the virtual impossibility even to contemplate the operation of our planned jet fleets without the essential ground facilities and aids.

The 1955 AGM endorsed this view through the medium of its widely publicized resolution, and I think it is fair to say that there is now universal agreement within both states and airlines as to the shape of the problem that is before us. However, realization of a problem is only one phase and we must further encourage states to seek and find the solutions. Should this endeavour by those who have any degree of responsibility for the advancement of civil aviation not succeed, a grave dis-service will have been rendered to the traveling public and the promised golden age of jet operation will just not materialize.

We have been forced to recognize a further important truth in our technical work —especially in planning for the future—and that is that we cannot work alone any longer, but in almost everything we do we must cooperate with all other users of the airspace to ensure that the technical solutions we develop will result in the minimum of conflict between our own and other people's operations.

Technical Conference

This is particularly so with respect to matters which are of both military and civil interest and I am happy to report that the air forces of several countries are not only cooperating with us most effectively, but also making most generous contributions based on their experience with advanced military type aircraft that have many features in common with those that we intend to operate in increasing numbers in a few years' time.

Once again the highlight of our year's activity has been the technical conference, and although I do not intend at this stage to deal in any detail with the outcome of the specific agenda items, I believe you will be interested to learn that the Ninth Technical Conference which was held in San Remo, Italy, during May, was our largest yet—in terms of attendance, the size of the agenda, and the potential economic consequences to the airlines of the discussions.

A record number of 350 experts, representing member airlines, other international organizations, air forces, research laboratories, and government agencies of many countries attended the two weeks of sessions. It was particularly gratifying to us to have three members of the IATA executive committee, as well as the director general, join us in our deliberations. Under the sub-headings of the balance of my report, I shall make reference to the conference findings as appropriate, rather than to deal with it as a separate section.

The interlocking relationship between

the majority of our technical activities and the wide field which must be covered introduce certain difficulties in presenting my report. Therefore, I would like to emphasize that the subject headings and division I have adopted are merely for convenience of presentation and should in no way be regarded as an indication that the subjects are capable of consideration in isolation. In this same connection the items I have covered are far from being all those that have demanded our attention, since I have attempted to highlight those which are of the greatest immediate significance and interest.

AIR TRAFFIC CONTROL

The somewhat generic title of this section of my report perhaps demands some explanation, since it really covers the entire technical field of aircraft operations. It concerns any technical matters which affect or contribute to the objective of air traffic control which, in the words of the 9th Technical Conference, is protection against collision with the minimum of restriction and the maximum of traffic flow.

While what I have to say on ATC matters reflects to a great extent the work and the views of the 9th Technical Conference, I must first of all make it quite clear that this was by no means the only occasion during the year when ATC demanded and received our attention. There were many aspects of ATC dealt with during the 2nd ICAO Air Navigation Conference and, additionally, we have held a number of purely airline meetings to consider both the world-wide and regional aspects of this subject. It is therefore true to say that the discussions during the Technical Conference represented the culmination of all our recent ATC efforts.

The Technical Conference made a two-pronged attack on this problem: those improvements to present systems which might enable them to handle the maximum possible load during the next five years; and the new systems and principles which must be developed to meet the demands of the first decade of high speed jet operations in 1961 to 1970.

In addition to compiling a great deal of factual data, the conference developed a series of 26 specific recommendations and conclusions and urged strenuously that ATC problems can be successfully solved only if we undertake these future activities jointly with the other users of the airspace —especially our military friends—and the ground authorities concerned with the provision of air traffic services.

The conference concluded that the systems of the future most suited to meet the objectives of air traffic control may depend upon forms of control or coordination appreciably different from ATC as we know it today. On the same theme, the search for the proper system of the future will have to proceed from the determination of agreed objective requirements, rather than through attempts to revise or expand devices now used or known.

Also emphasized was the necessity for substantial improvement in the standard of proficiency of ATC personnel in many areas of the world. In this regard, the Conference paid tribute to the work being

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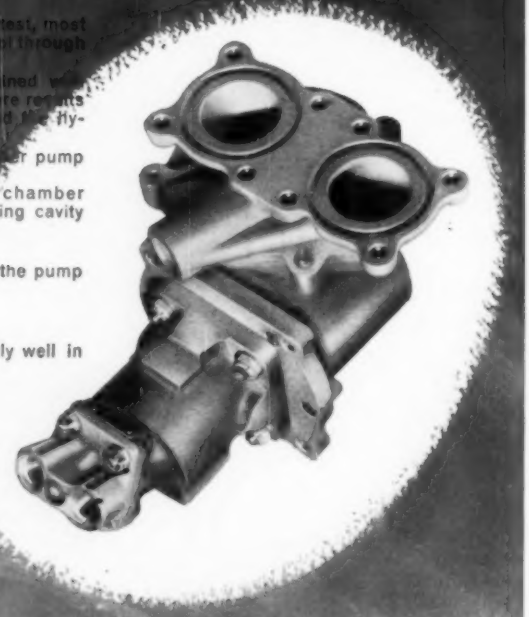

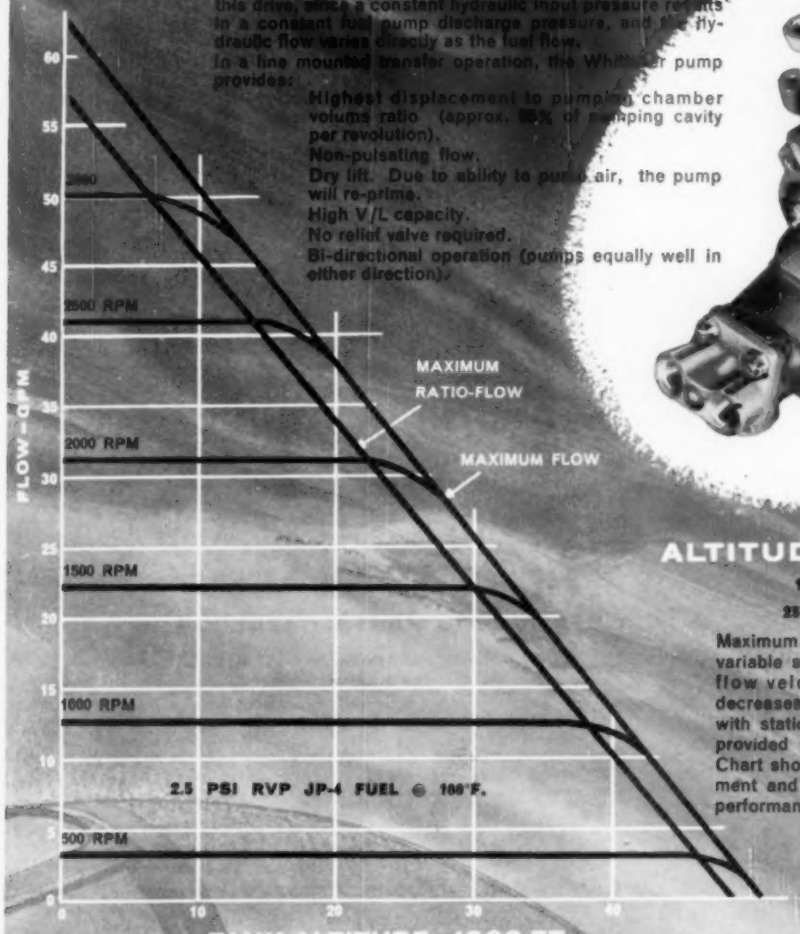

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done in some countries by ICAO Technical Assistance teams.

The conference considered that the ATC systems in 15 to 20 years time will not be fundamentally different in their aims from those used today, but that the increasing speed and density of traffic will require a spectacular increase in the speed of communications and an increasing measure of discipline on the part of the pilot and the operator.

The need for greater speed of communications to enable contact between controller and aircraft in a fraction of a second focused particular attention on the ATC signaling systems now being considered in a number of countries. The conference strongly recommended that these integrated data transfer and signaling systems be subjected to large-scale simulation evaluations, preferably by the joint efforts of states, in order to prove out their complex arrangements as fully as possible before they are put into actual service.

Area, Not Route

The conference discussed at length the computation and presentation of navigational information on aircraft and stressed the necessity for putting into the cockpit the type of instrumentation which would give the pilot a visual interpretation of his place in the ATC scheme.

While the conference noted that self-contained navigational aids independent of ground stations could be made available for civil use in the next few years, it pointed out that airlines have not yet had any experience with them, and they will thus initially have to be looked upon as complements to the present systems of ground-based aids.

Many of the existing control areas set up on a strictly national basis are extremely small and unsuited to the needs of aircraft operations; hence an aircraft requesting clearance through one such area has often passed into the next before the clearance can be granted. These excessively small areas also create unnecessary demands for communications and data transfer between adjacent control centers.

In dealing with the more immediate aspects of ATC, the technical conference made these recommendations for improvement:

- **Pending introduction** of automatic communications for continuous position fixing, present ATC procedures can be improved by use of standard phraseology and procedure and correct sequence in the transference of data, by speeding up transmissions and recording, and by instituting a standardized position reporting procedure for pilots.
- **Regardless of its limitations**, primary radar is "one of the best tools" with which ATC has been provided to meet the needs for reducing separation between aircraft to provide expeditious handling of traffic, and IATA should do everything possible to encourage the early development of an internationally agreed and compatible system of secondary radar.
- **In areas** where the frequency of position reports and navigational accuracy obtainable permit, longitudinal separation minima may be reduced and the load of position reporting cut. Regional and route-by-route studies

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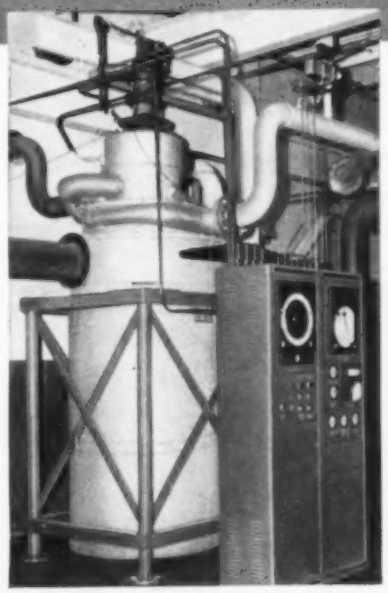

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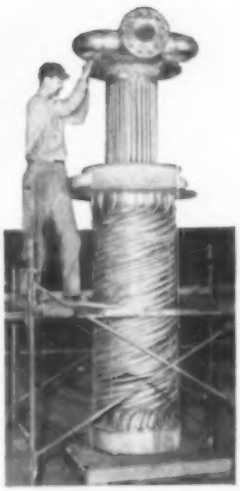

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of these possibilities were proposed and will be undertaken.

- **In areas** where congestion exists, all aircraft movements should be subject to regulation by air traffic control, even in weather permitting visual flight rules, so that the position of all aircraft in the airspace concerned will be known and can be provided for.
- **As an additional** measure, airlines should support experiments in the use of anti-collision lights on their aircraft, since results obtained so far have indicated that such lights can be of considerable value in improving aircraft conspicuity.
- **No aircraft** should be permitted to come closer than 500 ft. to another, whether for the purposes of operational identification by the military or for any other reason, and none should cross the heading of another in such proximity.
- **Due to the fact** that turbine-powered aircraft will hold places in the traffic pattern at considerably higher altitudes, the development of altimeters capable of providing accurate measurement at high altitudes is necessary so that they can maintain the 1,000 ft. vertical separation standard there.
- **Detailed study** is urgently needed to determine whether the maneuvers and holding patterns prescribed for piston-engined aircraft can be applied to advanced turbo-jets.

VERTICAL SEPARATION

One aspect of the broad subject of Air Traffic Control with which I have not yet dealt is that of ensuring adequate vertical separation between aircraft.

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Even though the pilots of two aircraft may be flying very accurately, one at an indicated altitude of 20,000 ft. and the other at an indicated altitude of 19,000 ft., it does not follow that they are necessarily separated by 1,000 ft. Due to the errors that exist in present day altimeters there is a possibility, admittedly not a very great one, that they could in fact be at very nearly the same level.

Very accurate altimeters which are capable of measuring the distance of an aircraft above ground level have, of course, been invented and are in use—but these are not of much use in effecting vertical separation between aircraft, particularly over rough terrain.

The instrument we still have to rely upon is the pressure altimeter, which measures

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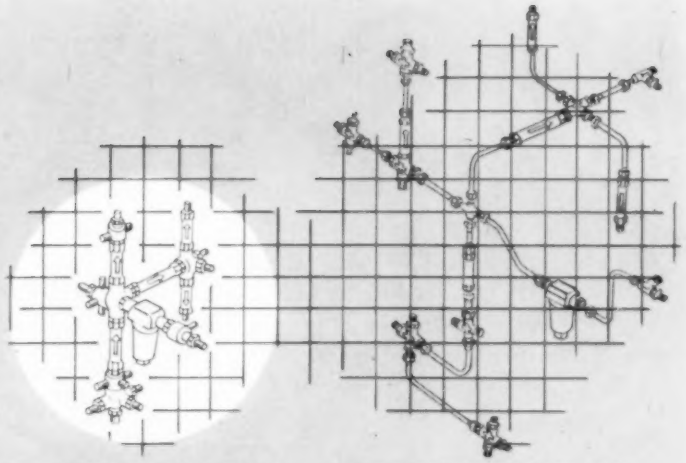

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the pressure produced by the weight of the column of air above it and converts that into an indication of altitude. This always seems to me to be a rather indirect means of measuring the quantity in which we are actually interested, but, for the purpose, it seems to be the best method that has yet been discovered.

Flight Level Indicator

You will recall that about two years ago one of my predecessors reported to you the results of a very thorough investigation which we had conducted on the accuracy of altimeters and the contribution of their errors towards the reduction of effective vertical separation. At that time we had come to the conclusion that the increasing number of aircraft using the airspace and the higher altitudes at which they would be flying would warrant our going to a new type of instrument in the future to ensure safe vertical separation.

Frankly we did not like having to come to this conclusion because it resulted in a recommendation for another instrument in the cockpit; but we did so out of what was considered to be sheer necessity.

I am therefore more than pleased to be able to report to you at this time that certain recent improvements in altimetry have been made which may result in our being able to revise our former conclusion. These developments are in the form of pressure altimeters of greatly increased accuracy. Briefly, the principal factors involved are new techniques in the manufacture and assembly of aneroid capsules and the replacement of mechanical linkages with electronic ones. These new altimeters are presently being produced but have not yet been service tested—at least by commercial operators.

I do not want to give the impression that our problems in the field of vertical separation are all solved. Far from it. These new altimeters are still subject to many of the errors associated with our present altimeters. Indeed some of the errors are inherent in the very principle on which pressure altimeters work.

However, the new developments appear to be a significant step in the right direction and we are all looking forward to a thorough assessment being made of them to see if the improvement will be sufficient to give us the safe separation we need without going to the expense and operational complexity of a new instrument in the cockpit.

AIRPORT REQUIREMENTS

The prospective large scale introduction of jet and turboprop transport aircraft has caused many airport authorities a good deal of concern. The general assumption seems to have been that the advent of these aircraft will necessitate major alterations in the principles of airport design.

Possibly this has stemmed from items that have appeared in the public press to the effect that many jets recently ordered by the airlines will require runway lengths of from 9000-11,000 ft. at sea level, and greater lengths at higher altitudes and at temperatures above standard. There has also been considerable concern about the ability of runways, taxiways and aprons to

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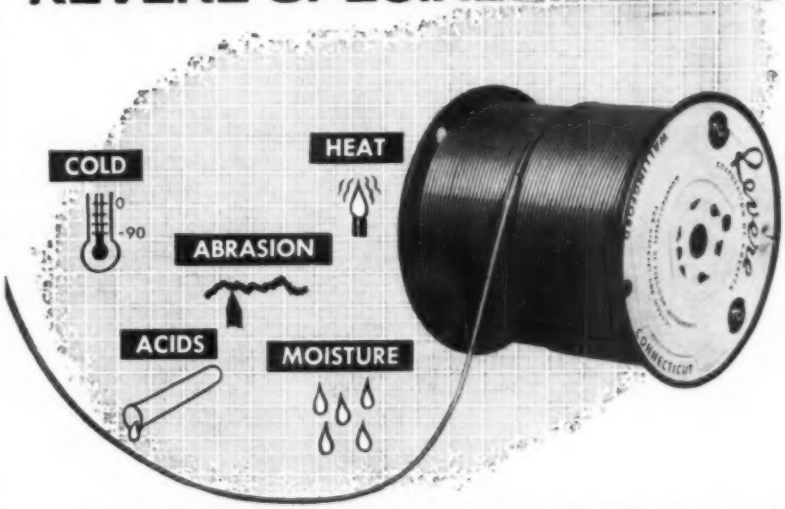

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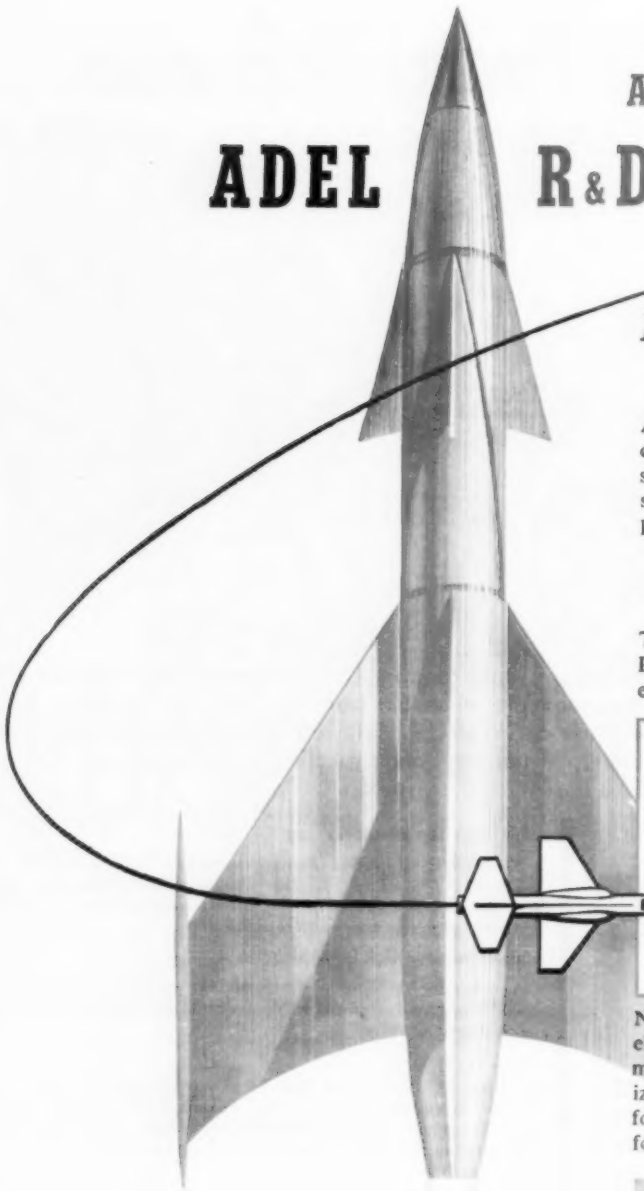

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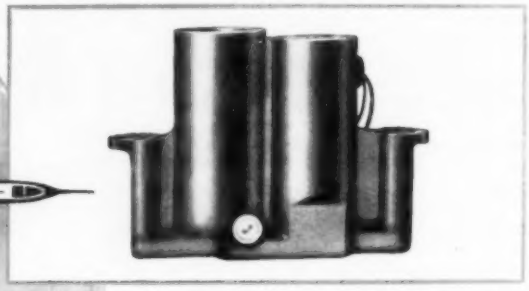

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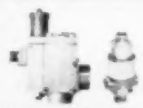
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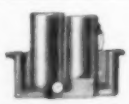
Hi-Temp Manual & Solenoid Operated Valves


Electric Motor Driven Hydraulic Power Packages

withstand the greater weight of these new airplanes.

This concern assumed such proportion this year that your experts decided it was necessary to put the problem into its proper perspective, in the hope of alleviating some of the qualms of the authorities about the airport demands of these new "monsters." . . .

Several of the new family of jet transports, and certain turboprop aircraft as well, will be capable of operating at maximum range over distances longer than possible with current transports. Over routes such as those flown today, the biggest new jets will take off at less than the maximum weight, and the length of present runways at many major airports will be adequate. However, some airports may become terminals for non-stop airline services over longer routes than they now originate, and will possibly need longer runways. Still others may emerge as traffic centers for very long range non-stop intercontinental flights of 4000 or more nautical miles, and in all probability will require additional runway lengths. However, such terminals will be few in number.

Runway, taxiway and apron pavement strength requirements will be about the same as for current transports. Because of the load distribution characteristics of four-wheel dual tandem main landing gears, runways and taxiways satisfactorily handling present airplanes can safely withstand even the loading of the big new jets at their maximum gross weights.

Cross-wind landing characteristics will be equal to or will be more satisfactory than those of civil transports now in operation.

The rate of climb of the new jet transports will be higher than that of conventional aircraft.

Turbine engine exhaust temperatures and velocity patterns are relatively insignificant factors. While they are high at the engine nozzle, they dissipate rapidly with distance.

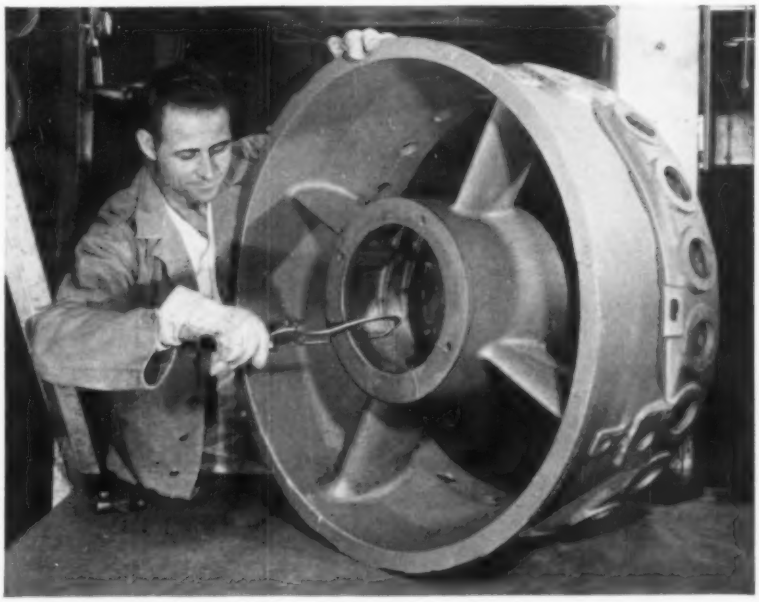
Debris Danger

Turbine engines, unfortunately, are very susceptible to damage from debris entering the engine intakes. Stones and other foreign objects lying on movement surfaces can be harmful to turboprop propellers due to their turning at higher speeds than conventionally driven propellers. These disadvantages can be overcome by meticulous attention to surface sweeping and clearing of nuts, bolts, stones, rags, etc. Aircraft servicing facilities contribute to the problem by accidentally depositing rubbish on the surface, and rigid policing and a great deal of understanding will be necessary by all concerned.

What effect will these characteristics have upon airport layout and design?

Considering that a modern heavy duty runway, with its associated utilities, taxiways and the like, may cost in excess of $1000 a foot—or $1 million for each 1,000 ft., not including land costs, it becomes clear that specific airport requirements must be studied on a local basis. Operators will be obliged, therefore, to present their needs to the local authorities, who must in turn take account of the variables of all the operations planned before making their decisions about a particular place. No general

QUALITY MAGNESIUM CASTINGS



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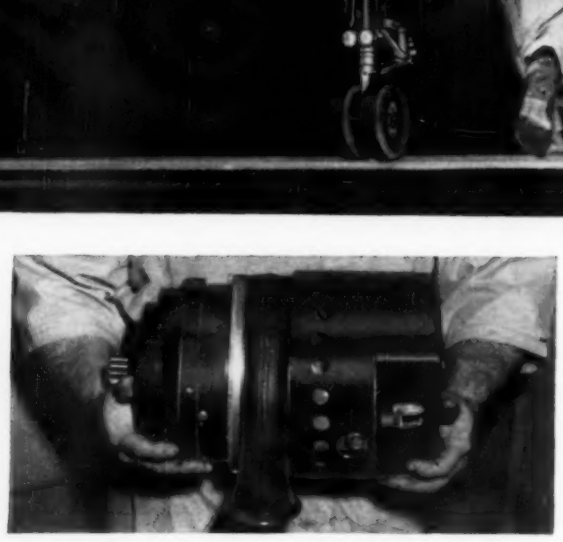

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and universal rule is possible, since requirements will vary for a particular aircraft, the stage lengths involved, the airline's operating practices, including the fuel reserves needed for specific routes, the performance code to which the state of registry will require the aircraft to be operated, etc.

We have emphasized the urgency of fixing these requirements as soon as they can possibly be determined, because at least two years is needed between the time the requirements are stated and the time the runway in question can be used operationally.

In some cases, states will find it economically impracticable to provide all the paved runway length which would be desirable. From the operational performance point of view, this can be partially overcome (depending upon how long an extension is necessary), by resorting to the use of a "stopway" at the end of a runway. This is an area beyond the end of a runway in the direction of take-off, selected or prepared as a suitable area in which an aircraft can be stopped after an interrupted take-off. The concept is derived from the fact that the part of the accelerate-stop distance not required for the takeoff run will be used very rarely and may, therefore, be constructed more economically than the surface required for the takeoff run, i.e. the runway itself.

A stopway should be so prepared or constructed as to enable the aircraft to come to a stop on it in exceptional cases and without hazard at the operating speeds that might be expected in this area after an interrupted take-off. One should be clear, however, that the provision of a stopway does not relieve a state of the necessity of providing an adequate length of runway for the safe landing of the aircraft the runway is intended to serve.

Variety of Systems

While, as already implied, most airports should be able to meet strength requirements, real difficulties are caused operators due to the variety of systems which are in use for expressing—and the information which is available concerning—pavement strengths. States generally quote either a maximum permitted all-up weight or an isolated single wheel load with or without an associated tire pressure. The former is generally recognized to be unsatisfactory, and while the latter is an improvement on it, it ignores some of the variables which must be taken into account.

In consequence, the situation can arise, and in fact has arisen, where an aircraft is not allowed to operate at an airport that is already being used by another type which, in fact, imposes a greater load on the pavement, but at a lower all-up weight or nominal isolated single wheel load. In some cases, no data whatever is available on airport strengths. The only way of avoiding situations such as this in the future is for ICAO to determine, as a matter of urgency, the particular information which should be available at airports respecting the bearing capacity of pavements. In all probability, this will be decided at the AGA Division a few months hence.

It appears that turbine aircraft will not require wider runways. In fact, their crosswind characteristics and their maneuverabil-

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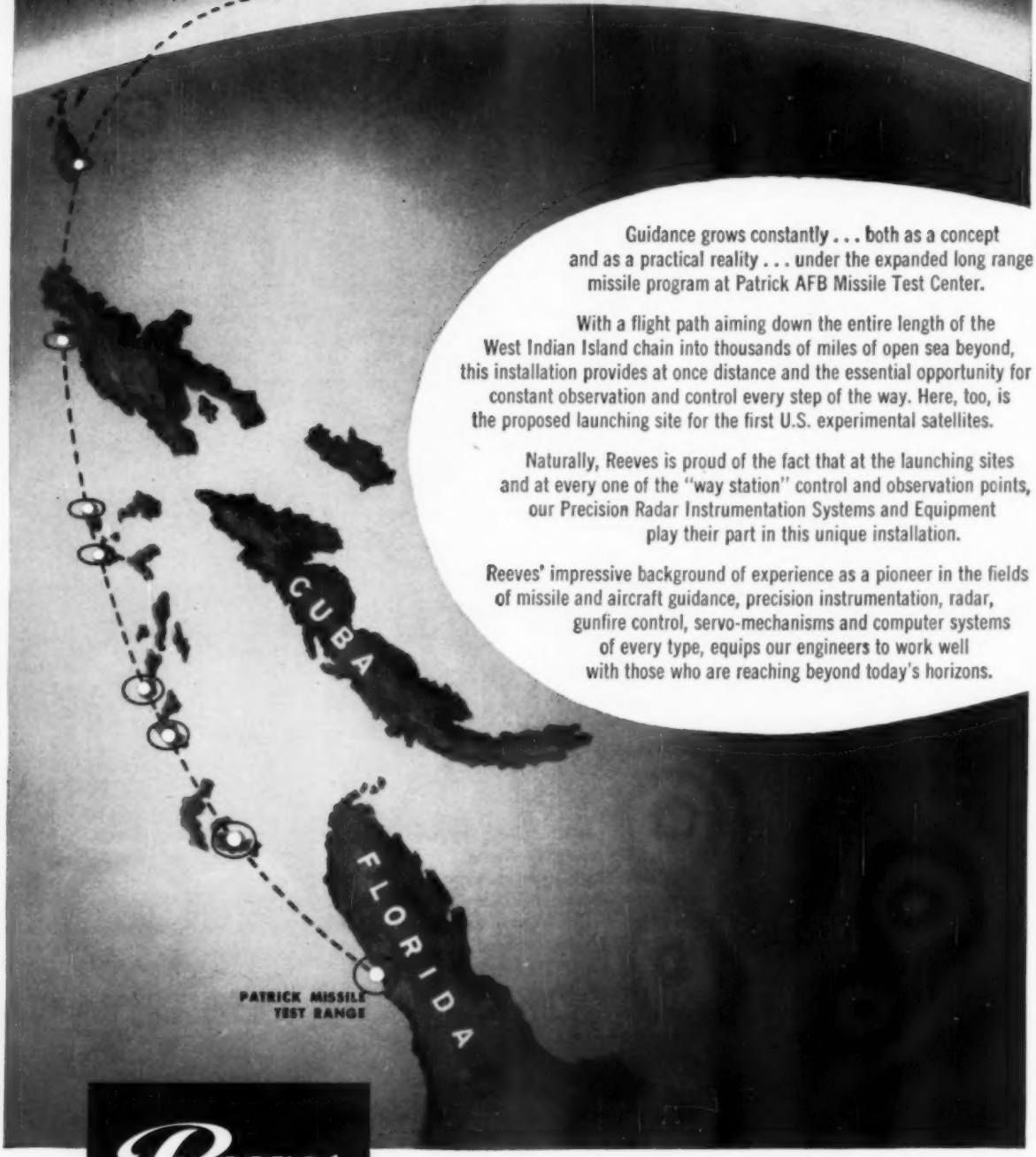

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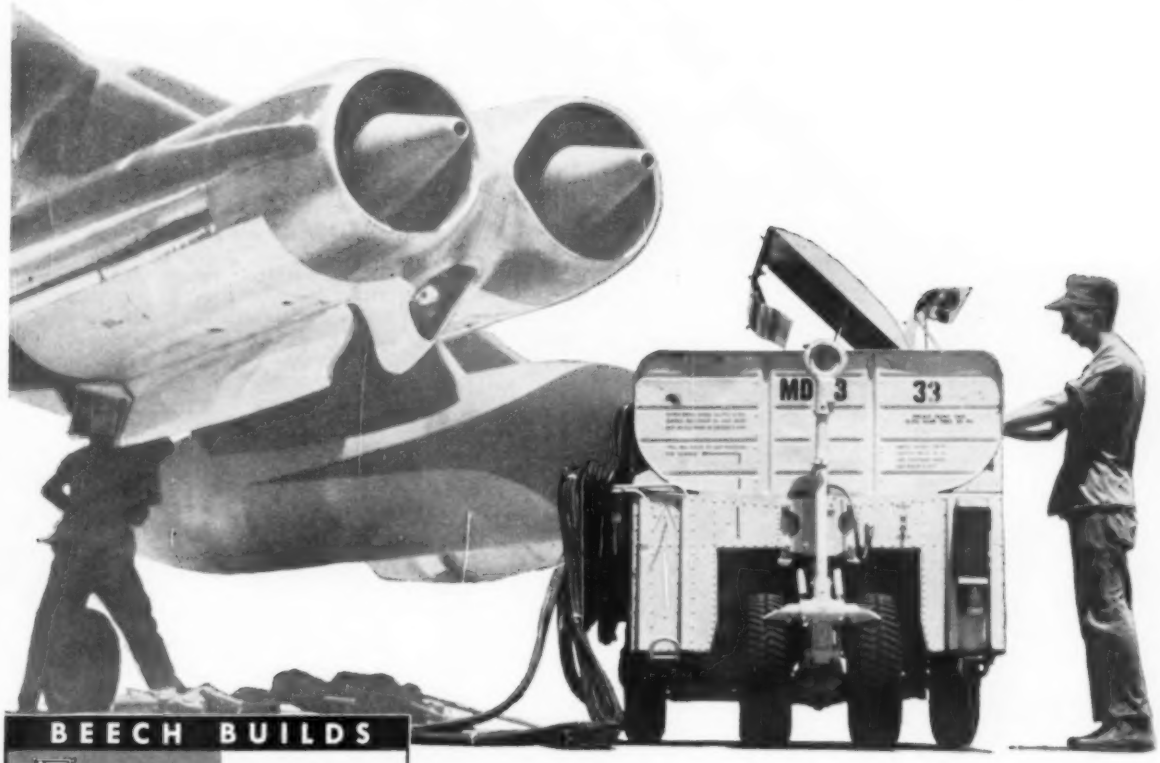
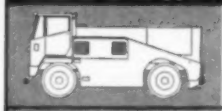
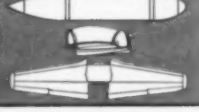


BEECH BUILDS	
	MA-3 MULTI-PURPOSE VEHICLES
	C-26, MD-3 POWER UNITS
	8-PLACE BEECHCRAFT SUPER 18
	6-PLACE BEECHCRAFT TWIN-BONANZA
	4-PLACE BEECHCRAFT BONANZA
	BEECHCRAFT T-34 TRAINERS
	BEECHCRAFT L-23 TRANSPORTS
	TANK-WING-MAJOR SUBASSEMBLY SUBCONTRACT PRODUCTION

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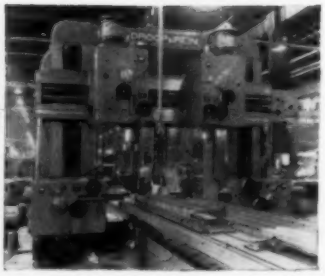

Giant 25-foot Droop & Rein universal planer mill, only one of its kind in the country, was recently installed at Twin Coach Aircraft Division.

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ity have led us to believe that a width of 150 ft. will be adequate, provided that such runways are equipped with "sideways" or stabilized shoulders strong enough to support an aircraft without harm to it should it happen to go off the edge of the runway. However, where crosswinds of the order of 20 kt. are frequently encountered, it may be necessary to provide additional runways or widen the existing runway. In special cases, such as the existence of high snow banks, runways wider than 150 ft. may also be needed.

The flight paths of the new generation of aircraft make it appear that obstruction clearing to the existing ICAO formula will be satisfactory.

The jet efflux of civil transport aircraft will not cause deterioration of conventional runway and taxiway surfaces and, therefore, no special treatment of these surfaces will be required. Small amounts of jet fuel may possibly be spilled at parking bays, e.g. during refueling, and its most serious effect is the deterioration of bituminous surfaces.

Taxiway widths of not less than 75 ft. should be planned. Surface sweeping and clearing of widths greater than this amount will be needed, owing to low propeller clearances of turboprop aircraft and turbojets fitted with pods so spaced that they extend beyond the edges of the taxiway. For reasons of economy, it would appear unnecessary that such additional widths should be stressed to any particular load bearing capacity, but they should be surfaced.

There is a requirement for high speed lead-off taxiways, even at low density airports, in the interests of reducing transit times. However, the number and the position along the runway and the optimum radius of curvature of such taxiways can only be decided after an examination of the volume and type of traffic that might be using any particular airport.

AIRPORT BUILDINGS, APRONS

You will recall that last year the chairman of the technical committee reported to you on the importance of "lost ground time" on airline efficiency and economy. It was noted that much could be done to reduce this time through proper design of airport buildings and aprons, and that plans had been made for the preparation within IATA of a comprehensive reference document that would constitute an agreed airline position in respect of organization and facilities required at airports to provide for rapid turn-around of aircraft and smooth functional flow of passengers, crews, cargo and baggage.

In observing the many airport building and apron projects that are currently being undertaken, and those which have been undertaken in the past, it has been observed that there has been a remarkable lack of uniformity in layout and design.

The reference here is not to superficial detail but to basic fundamentals affecting operating efficiency. In many cases the airlines concerned have either not been consulted at all or have been consulted too late to enable their operational requirements to be taken into account.

In addition, it has all too frequently happened that plans for such projects have been based upon requirements that were

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Elimination of thermocouple reference junction errors in all kinds of airborne applications, guided missiles, rockets, is now possible with T-E's new, miniature "AutoRef." A compensating bridge type unit, this "AutoRef" is individually constructed for all standard T/C materials. It weighs only 12 oz. Case size is approximately 1¼" x 2⅝" x 3", mounted on a 3" x 3⅜" base. Potted after assembly in hi-temp RTV silastic, it will withstand severe conditions of vibration, acceleration and shock—no adverse effects from immersion in water. There are no vacuum tubes and relays. Only components used are resistors and other static devices suitable for extremely "tough" conditions. None of these require replacement.

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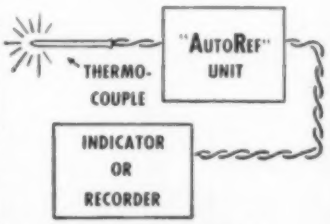

Typical Application Circuit

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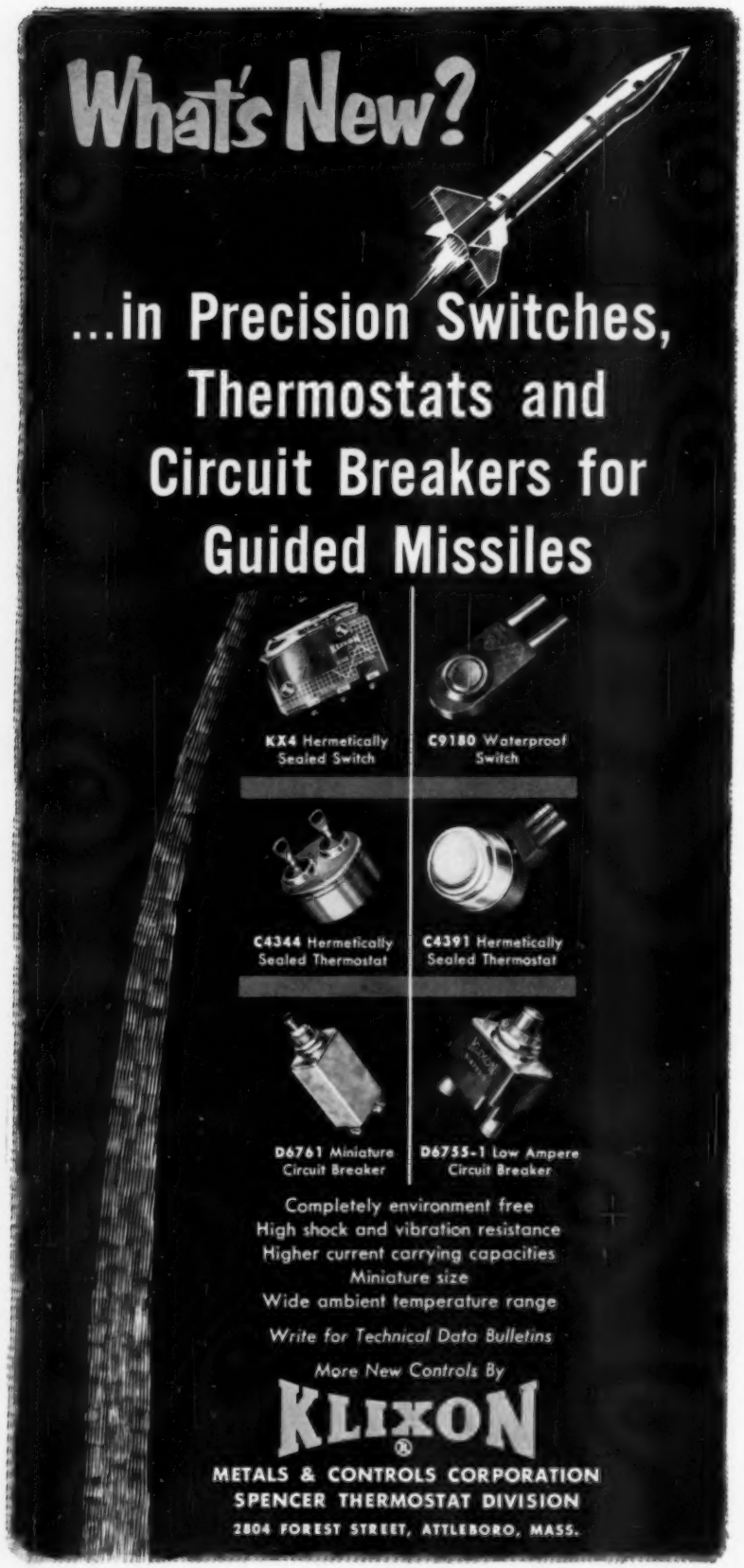
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totally unrelated in time to the expected life of the facilities provided. As a result of these factors, the functional aspect of many airport buildings and aprons has rapidly become inadequate and out of date.

The importance of this lack of coordinated planning was officially recognized within IATA about a year ago and a study group, representative of all airline interests, was set up to establish the operators' position with respect to airport buildings, aprons and associated facilities. This group proved to be a very hard working one indeed and at the end of two meetings had developed a 100-page reference document of principles and guidance material for use by administrations and operators alike. I am pleased to report to you that this document has been made available to all branches of the industry, and to assure you that throughout the document due emphasis has been placed on the fundamental requirement that in planning airport facilities the appropriate authorities should ensure early and continuous consultation with the airlines.

In developing this reference document every effort has been made to keep its contents sufficiently basic to be universally applicable and subject to a minimum of change with the passage of time, but sufficiently specific to be of practical value. As further operating experience is gained, particularly with turbojet aircraft, it will no doubt be found necessary to add to the material contained in the present issue. As a matter of fact, I might mention that the foundation has already been laid for certain work that will probably lead to the first amendment. An exchange of views was scheduled during the 9th Technical Conference on the subjects of fixed servicing installations, mechanical conveyor systems for aircraft, passengers and loads, and special problems related to turbine aircraft. The material contained in the first edition of the reference document is not very specific on these three subjects. It is planned, therefore, to develop further principles and guidance material pertaining to them, using as a starting point the material that emerged from the exchange of views to which I have just referred.

VISUAL AIDS

Last year it was reported to you that we were devoting a great deal of effort towards reaching early agreement on improvements needed in the lighting of instrument runways. There are several reasons for this, and possibly the most important are: firstly, improvements are needed to raise the safety level of existing operations at current operating minima, and secondly, improvements are required if we are to achieve our goal of lower limits and better regularity of operations.

We continued this work quite intensively during the past year, and I am glad to report that we have been able to make specific recommendations. These are particularly pertinent because the AGA Division of ICAO—where this matter will be carefully investigated and recommendations made by states—will be held just a few months hence.

The main and most novel features of the lighting configuration we have recommended for instrument runways can be likened to a

railway track laid down the middle of the runway for a distance of 3000 ft. from the threshold.

Imagine that the "rails" of this track are 75 ft. apart, and that the distance between the "ties" is 100 ft. A lighting unit, flush with the runway surface is placed at each point where a "rail" crosses a "tie" throughout the 3000-ft. distance.

These buried lights are so designed that aircraft can safely roll over them without damage to either. There are several ways of designing such lighting units, the most popular at the moment consisting of several lamps in an open pit covered with a grill. The lamps are arranged so as to shine through the grill towards an approaching aircraft. Appropriately enough, this part of the configuration has been termed the "narrow visual gauge."

Straddling the "narrow gauge" is a wider track of lights which we have called the "wide visual gauge."

Elevated high intensity runway lights—the kind normally installed on instrument runways—are used in this part of the configuration. To all intents and purposes, the "wide gauge" is identical with present-day runway edge lighting on instrument runways.

Painted Markings

Supplementing these two gauges are special arrangements of lights and painted runway markings placed at fixed distances from the threshold to provide the pilot with distance, distance interval, and other information.

On a subject such as this where so much depends upon the complex inter-relationship of numerous factors—for example, human engineering (physiology, optics and psychology), pilots' operational experience, aircraft characteristics, airport design and economics, etc., the complete reasons for this particular configuration would be almost impossible to express, even in an exhaustive report. It is therefore quite sufficient, in my opinion, to state that these decisions are based on the best judgment, at this time, of airline representatives after very full consideration of all relevant factors. In this work they have been greatly assisted by experts from government administrations, research establishments, and industrial organizations, who have provided most valuable advice and information, and our thanks go out to them for their help.

While one cannot, with any degree of certainty, guess whether our recommendations will be wholly accepted by ICAO, I would hope that the presence of "outside" advisers at our meetings will help their passage through the AGA Division next March, and that they will end up as ICAO's own recommendations on a matter which is so important to us for safety and regularity.

Improvements in the lighting of instrument runways will not solve all our problems, however. There is an urgent and equally important requirement for improved visual aids to approach and landing at many airports where the lower ranges of visibility are rarely encountered but where other considerations present the pilot with an extremely difficult task and can cause serious visual misjudgments to be made. One obvious example of this is an ap-

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proach over water, where there is literally nothing to provide the pilot with the depth perception he requires for orientation in three-dimensional space.

We have accordingly made certain proposals in the hope of overcoming difficulties such as these. Our proposals consist essentially of improved threshold lighting and marking, better delineation of the area at the beginning of the runway and, where it can be installed on the extension of the runway center-line, low intensity approach lighting with its all-important cross bars. While time does not permit me to go into details of our recommendations, I must mention that we have recognized that a single set of requirements will not be applicable in all cases. Therefore, having regard to economic or physical difficulties, the recommendations cover varying conditions and, because it may be necessary to undertake implementation in steps, we have offered operational guidance on the order in which particular improvements would be preferred.

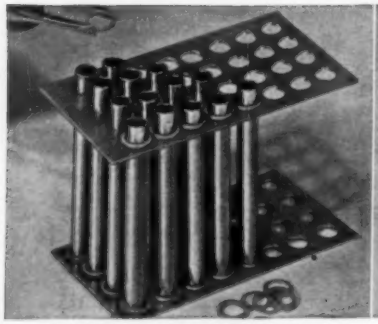
This is one subject on which we have ICAO's fullest sympathy and backing. We had hardly made a case to its Air Navigation Commission about the question late last year before they decided that some sort of activity should be commenced at once. They immediately established a working group, which developed a treatise of the problem and suggested certain possible solutions which very closely approximate our own. These are now being considered by States and will be reviewed this autumn by an ICAO Technical Panel of experts, which has been especially set up with the objective of reaching preliminary agreement and easing the task of the AGA Division in March, 1957. I am confident that the outcome will be favorable, and will help convince airport authorities that improvements must be made to the visual aids on other than instrument runways in the interests of safety.

AIRCRAFT CHARACTERISTICS IN THE APPROACH AND LANDING PHASE

The visual aids aspect which I have just mentioned is only one, albeit a very important one, of the many factors which contribute to approach success. Other factors involved are non-visual approach aids, pilot technique, weather minima, aircraft controllability and stability, flare characteristics, braking efficiency, etc.

Up to the time of our 9th Technical Conference, almost all of the effort in our work on approach and landing had been devoted to consideration of the facilities and aids required to conduct the operation safely. It had been possible to devote only a relatively small amount of time to consideration of the aircraft itself. Advantage was therefore taken of the presence of the many experts who attended the San Remo Conference to examine in detail the characteristics of aircraft in the approach and landing phase and to assess their contribution to the overall success of the operation.

The first consideration was, of course, speed. When a pilot "breaks through" on the approach at, say, 200 ft. he must first of all determine exactly where he is relative to the end of the runway, he must make



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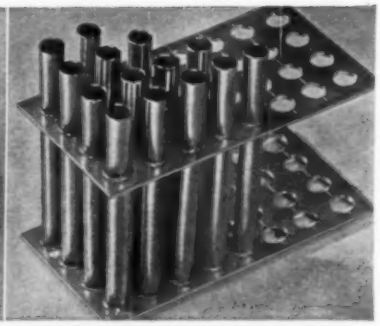

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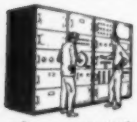

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corrections to get his aircraft properly lined up, he must change the configuration of his aircraft and he must get it slowed down.

Obviously the time he has at his disposal to do all these things is inversely proportional to the speed at which he is traveling. If his speed is too high he just does not have enough time to get everything sorted out before he gets to the end of the runway and he has to go back up and go through the whole procedure of a second approach. The implications of high approach speed on both safety and economy thus becomes immediately apparent.

There is nothing new of course in operators wanting lower approach speeds. The question discussed in San Remo, therefore, was not the desirability of improvement in this direction but the possibility of manufacturers being able to do something at a price that operators could afford. In essence, the reply from the manufacturers was that they could give operators anything they wanted, but that the price would be considerable in terms of economic operating efficiency. The design of an aircraft, they pointed out, was a very delicate balance of many factors; improvement in any one characteristic could usually be had at the expense of a disproportionate sacrifice in another. It was their firm belief that all factors taken into consideration the aircraft they produced represented the optimum balance as far as could be determined by the state of the art.

Various developments in boundary layer control were believed to hold considerable promise in reducing the approach speeds of future aircraft. One opinion expressed was that reductions of the order of 50 mph. could be expected through this medium. Before raising undue hope in this direction, however, I must report that there are still many technical problems to be solved and that the majority opinion of the meeting was that it would be at least 15 to 20 years before such devices could be expected to appear, if ever, on commercial transport aircraft.

Relatively Satisfied

A discussion on the stability and control characteristics of modern transport aircraft revealed that pilots were relatively satisfied with what they had. It was recognized, of course, that nothing is so perfect that it cannot be improved upon, but in general it was felt that the evolutionary improvements being made by manufacturers were proceeding at a satisfactory pace. In other words, the stability and control characteristics of modern aircraft did not appear to be one of the critical considerations in determining approach and landing success.

Airlines were loud in their praise of recent developments in automatic (anti-skid) brakes. Several airlines are now using aircraft equipped with these devices and have found them to be most satisfactory—not only from the point of view of being able to stop the aircraft in a shorter distance but also from the point of view of possible reduction of tire wear.

Recent design improvements in spoilers were held to be of particular significance in providing flexibility of approach angle and in getting the lift off the wing after touchdown, thus permitting more effective wheel

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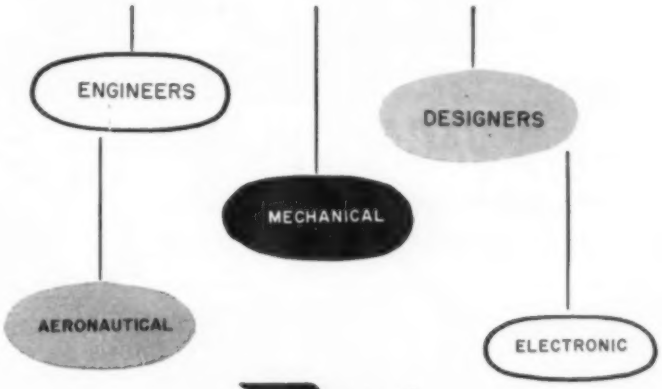

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braking. It was reported by one manufacturer that, with the latest type of spoiler, it was possible to get 85% of the weight of the aircraft on to the wheels within 5% of the landing roll after touchdown.

Developments in reverse jet thrust were discussed. Figures presented by one manufacturer indicated that with current designs, reverse thrust up to 40%-60% of full power were obtainable at a cost in weight of about 50-60 lb. per engine. The use of such devices, it was stated, would introduce no loss in forward thrust.

It was reported, too, that thrust reversers were being combined with noise suppressors. The combination would weigh about 150-200 lb. per engine, and some loss in forward thrust would result from the silencer.

On the subject of cockpit characteristics, there was considerable discussion on the need for better means of windscreen clearing.

One manufacturer mentioned the use of a high temperature, high pressure air blast across the windscreen in one of the newer jet transports. This design was reported to work quite satisfactorily.

I could go on for some time high-lighting various points which emerged from this very interesting discussion, but the exchange of views which took place is fully recorded in the conference report and I would refer those of you who are more interested in this subject to that document. My purpose in reporting on the item here is only to give you a thumb-nail sketch of the scope of the subject matter discussed.

Air Noise, Vibration Brings on Suits

A suit asking another half-million dollars in damages from operators and users of the Seattle-Tacoma International Airport has been filed at Seattle by owners of 43 properties near the north end of the field.

Several similar suits, totaling more than $1 million in requested damages, have been filed in the past year. Defendants include the Port of Seattle, operator of the field, and the following airlines: Alaska Airlines, Northwest Airlines, Pacific Northern Airlines, Pan American World Airways, United Air Lines, Western Airlines and Trans-Canada Airways. All the suits complain about the noise and vibrations from airplanes using the field.

The port has plans to lengthen the runways and also has instituted various takeoff and landing rules in an attempt to meet the complaints.

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Sundstrand Machine Tool Co., Rockford, Ill., constant speed drives, 30 KVA, transmission, 186 ea.; frequency and load controller, 138 ea.; automatic paralleling control, 84 ea. (PR 159377-2 and 159377-3 Q), $6,965,982.

Ford Motor Co., 3000 Schafer Rd., Dearborn, Mich., Aircraft Engine Div., 7401 S. Cicero Avenue, Chicago 29, Ill., implementation for production of turbo-jet aircraft engines (PR 636132), job, $900,000.

Mergenthaler Linotype Co., Park Ave. and Ryerson St., Brooklyn 5, N. Y., M-1 toss bomb computers, aerno 52-6325 spare components, spare parts, MT & TE (PR 709873), 1685 ea, $2,065,849.

Hughes Aircraft Co., Florence Ave. and Teale St., Culver City, Cal., fire control systems, fighter, interceptor, fixed, type MG-3 for F-102A type aircraft A7A-4843C, 491 ea.; controls, automatic flight, interceptor aircraft F-102A, 491 ea.; receiving sets, radio AN/ARR-44, A7A-7444A, 491 ea. (PR 218563, 218492 and 218473), $31,323,384.

Hughes Aircraft Co., Florence Ave. and Teale Street, Culver City, Cal., fire control systems, fighter, interceptor, fixed, MG-3T type, for F-102 type aircraft A7A-4843C, 31 ea.; receiving sets, radio AN/ARR (data link) 44, A7A-7444A, 31 ea.; fire control systems, fighter, interceptor, fixed, type MG-3T for F-102 type aircraft, 28 ea. (PR 218423, 218439, 218439-1, 218440 and 218440-1), $3,069,443.

Sundstrand Machine Tool Co., Rockford, Ill., transmission and governor assemblies, aerno 48-514 (PR OC-691775 and 691776 Q), 200 ea, $647,200.

General Electric Co., Johnson City, N. Y., MD-1A F. C. S. spares components and parts (PR 177902, 177902-1, 177902-2, 219456), $2,376,931.

A. R. F. Products, Inc., 7627 Lake St., River Forest, Ill., receivers, R-322A/ARN-18 (PR PE 168009, SB 464632, MIPR R-55-2659-127-AER amend. No. 4), 1654 ea., $482,496.

Leland Electric Co. Div. of American Machine and Foundry Co., Dayton 1, Ohio, motor generator, 750 VA (PR 663514 and 663514-1 Q), 39 ea., $29,185.

General Electric Co., X-Ray Dept., 4855 Electric Ave., Milwaukee, Wis., 0-20 radar recording cameras, spare parts, engineering data, handbook data, lube data and details specification therefore (PR EC-A 636286, 427589, 671448 and 671449), 76 ea., $259,100.

Minneapolis-Honeywell Regulator Co., 2600 Ridgeway Road., Minneapolis, Minn., repair and modification of government furnished type MB-1 autopilot components (PR 709838 and 609838-1), job, $50,542.

Westinghouse Electric Corp., 32 N. Main St., Dayton, Ohio., motor assemblies and data (PR SA-663522 Q), $57,816.

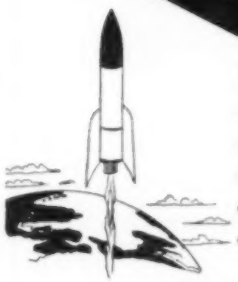
General Elec. Co., French Road, Utica, N. Y., indicators, azimuth, APG-41B radar, 108 ea.; controls, radar APG-41B, 148 ea.; frequency converters, APG-41B radar, 149 ea.; waveguide assemblies, APG-41B radar, 211 ea. (PR WR 407601, 407602, 407608, 407962, 407613 and 433537), $500,000.

Engr. Produces, Radio Corp. of America, Camden 2, N. J., radio receiver-transmitter, RT-263/ARC-34, 2500 ea.; radio set controls, 2500 ea.; spare parts, test equipment and data, A7A-6834A, lot. (PR PE 670782 and 670782-1), $10,513,058.

Ampex Corp., 934 Charter St., Redwood City, Cal., ampex model 804, 1 ea.; ampex model 307-4, 5 ea.; ampex model 300, 2 ea. (PR ATI-56-LP-89, ATI-56LP-96 and ATI-56-LP-122), $54,086.

The Lewis Engineering Co., 339 Church St., Naugatuck, Conn., lead thermocouple iron constanton, P/N L1411.00, 1429 ea.; lead thermocouple iron constanton, P/N L221-5, 1709 ea.; lead thermocuple iron constanton, P/N L457B-7, 1760 ea. (PR 598562), $28997.

Airesearch Mfg. Co., Div. of Garrett Corp.,



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Los Angeles, Calif., nut, assemblies, P/N 4280-27292, 192 ea.; actuator, assemblies, P/N 4280-31972-1, 133 ea.; shaft assemblies, P/N 4280-28664-10-10, 170 ea. (PR SA-663525 and SA-663526 Q), $178,702.

Crosley Div., Avco Mfg. Corp., 2630 Glendale-Millford Rd., Cincinnati 15, Ohio, computer, fire control system, 174 ea.; drive assembly, fire control system, 41 ea.; box assembly, fire control system, 189 ea.; junction box, fire control system, 43 ea. (PR WR 407959 and 433543), $1,180,696.

General Motors Corp., Allison Div. Aeroproducts Operations, Dayton 1, Ohio, A644-FN-C2 propellers, 88 ea.; P/N 4002-6502047, deicing controls, 88 ea.; P/N 4002-650775, regulator, 88 ea. (PR 717514 and 717514-1), $1,589,561.

Westinghouse Elec. Corp., 32 N. Main St., Dayton 2, Ohio, rudder control valve, P/N 1JC905-G1, 163 ea.; correlator, P/N 1JD-449-G3, 69 ea.; ILS coupler, P/N 1JD-387-G3, 5 ea.; engineering data (PR (MA) 597425/597425-1 Q), $316,853.

General Electric Co., French Rd., Utica, N. Y., AN/ARR-39A, data link equipment complete, 1121 ea.; spare parts test equipment and data, lot. (PR PE 168050, 168050-1, GS-561456, GE-561456-1, GE-561456-2), $11,578,096.

Westinghouse Electric Corp., Dayton, Ohio, panels, 215 ea.; racks, 139 ea. (PR 635613 Q), $184,014.

Raymond Rosen Engineering Products, Inc., 32nd and Walnut Sts., Philadelphia 4, Pa., telemetric data receiving set AN/UKR-2, 5 ea.; telemetric data, 3 ea.; telemetric data transmitting set AN/AKT-7, 41 ea. (PR 561454, 561454-1, -2, -3, 561455 and MIPR R56-2724-57-Aer), $988,648.

Radio Corp. of America, Engineering Products Div., Front and Cooper Streets, Camden, N. J., receiver-transmitter, RT/128A, 116 ea.; power supply, PP-298, 271 ea. (PR PE 168006 and 180876), $1,932,099.

Bendix Aviation Corp., Red Bank Div., Eatontown, N. J., inverters, 5000VA, 791 ea. (PR SB 503226, PE 635735 and SM-537229), $580,410.

Thomas A. Edison, Inc., West Orange, N. J., fire detector thermo type F-1 (PR SA-611352), 16047 ea., $33,698.

Kollsman Instrument Corp., 80-08 45th Ave., Elmhurst, N. Y., altimeter, pressure, range O-80000 ft. (PR 635940), 1419 ea., $202,207.

Hughes Aircraft Co., Florence Ave and Teale St., Culver City, Cal., fire control portion, fighter, interceptor, fixed, 133 ea.; type MG-3 for TF-102A type aircraft; automotive flight control portion, interceptor aircraft TF-102A, receiving sets, radio, 133 ea. (PR 709846 and amend. no. 1), $3,667,472.

Color Corp. of America, Houston Fearless Div., 11801 Olympic Blvd., Los Angeles 64, Cal., pump assembly (PR 599811), 238 ea., $26,775.

Chicago Aerial Industries, Inc., 1980 Hawthorne Ave., Melrose Park, Ill., type KD-2 oscilloscope recording camera with adapter plates (MIPR R56-2365-36-Aer), 222 ea., $214,230.

Sundstrand Machine Tool Co., Sundstrand Aviation Division, Rockford, Ill., overspeed control valves (PR 665397), 163 ea., $25,754.

Mitchell Camera Corp., 666 W. Harvard St., Glendale 4, Cal., 16mm motion picture camera (PR MO-599906), 5 ea., $26,431.

General Electric Co., Aircraft Gas Turbine Div., Cincinnati, Ohio, harness assembly, thermocouple (PR 662656 and 662656-1), 30848 ea., $1,307,338.

Eastman Kodak Co., Rochester 4, N. Y., KB-9A gun camera, 2312 ea.; electrical attachment plate, 4624 ea.; boresights, 300 ea. (MIPR R56-2411-139-Aer), $368,588.

Stratford Pen Corp., 44 W. 28th St., New York, N. Y., amplifier, (PR 642903 and 642911), 2875 ea., $222,812.

Curtiss-Wright Corp., Propeller Div., Caldwell, N. J., synchronizer assemblies, S/N 4006-152458, 163 ea.; brush assemblies, S/N 4006-129823, 1089 ea.; relay assemblies, nacelle, S/N 44006-146829, 200 ea. (PR's 408243, 40823-1, 420782, 420783, 420784, 408270 and 420792), $985,315.

The Roflan Co., Corner Route 1 and Camp Meeting Road, Topsfield, Mass., MX-1131A/ARC-36 modification kit, 458 ea.; adapter sub-assembly, P/O UG-613/U, 124 ea.;

retainer crystal holder, P/O CW221A/U, 496 ea.; latch assembly steel, PO ARC-36, 124 ea.; engineering & maintenance data, lot. (PR GE-642845, -1, 2, -3, GE-561146, -1, -2), $45,873.

Western Design and Mfg. Corp., Santa Barbara Airport, Goleta, Calif., actuator-electro-mec. rotary 26V DC single drive serrated shaft drive reversible (PR SA-535262), 89 ea., $29,993.

Viewlex, Inc., 35-01 Queens Blvd., Long Island City 1, N. Y., projector AP-1, 1615 ea.; data, 1 lot.; drawings, 24 sets (PR 600061, 600061-1, 736866, 736895, 736895-1 and 736604), $184,079.

Minneapolis-Honeywell Regulator Co., 2600 Ridgewood Rd., Minneapolis, Minn., gyroscope, HAC P/N 420-57-0013, S/N 5200-309685 (PR WR-408205), 500 ea., $477,500.

Bendix Aviation Corp., Pioneer-Central Division, Daveport, Iowa, transmitter, rate of flow, fuel, type J-2, (PR 718585), 731 ea., $137,325.

General Electric Co., 600 Main Street, Johnson City, N. Y., antenna for fire control system, S/N 4901-171E506G1, 61 ea.; antenna, fire control system, S/N 5901-521-E169G2, 19 ea.; frequency converter, FCS S/N 5901-763012AG1, 2 ea. (PR's WR 407-961, 407605, 407963), $845,638.

Radio Corp. of America, Inc., Camden 2, N. J., replenishment spares for E-4, E-5 and E-6 fire control systems (PR's WR-407634-1, WR-407775 and WR-408277), $170,855.

Hughes Aircraft Co., Florence Ave. and Teale St., Culver City, Cal., antenna assembly, P/N HAC 435-17-3001-1, 67 ea.; receiver-transmitter, P/N HAC-435-11-3001, 140 ea.; synchronizer, P/N 435-03-0001-1, 100 ea (PR WR-408212), $1345521.

General Electric Co., X-Ray Dept., 4855 Electric Ave., Milwaukee, Wis., C-7 camera bodies, 46 ea. M-2 controls, 40 ea. (PR EC-A 671459, am. no. 1, 671461, 671464 and 671479), $137960.

Standard Coil Products Corp., Kollsman Instrument Corp., 80108 45th Ave., Elmhurst, N. Y., type MC-1 log absolute pressure transmitter (PR 635918, 599225, 599226), 911 ea, $147809.

Jack and Heintz, Inc., Cleveland 1, Ohio, 422-DA15-4 motor assemblies, engineering data, maintenance data. (PR SA-611274 "Q"), 61 ea. $51434.

Fairchild Camera & Instrument Corp., Robbins Lane, Syosset, Long Island, N. Y., type C-2 lens cone for KA-1 camera, spare parts, maintenance tools and data. (PR 143019), 156 ea, $560276.

Bendix Aviation Corp., Montrose Div., South Montrose, Pa., transmitter, multi-purpose, type MS 28005-1 (PR 635969), 5076 ea, $285931.

Aero Instrument Co., 5105 Denison Avenue, Cleveland, Ohio, tube-airspeed electrically heat pitot type (PR 635956), 3953 ea, $34786.

Sundstrand Machine Tool Co., Sundstrand Aviation Div., Rockford, Ill., constant speed drives in a/w Convair specs No. 8-06282, consisting of transmission, 11 ea. gear boxes, 13 ea. engine mounted gear box assemblies, 11 ea. (PR PE 694303 and PE 694304 Q), $233274.

Pacific Div., Bendix Aviation Corp., North Hollywood, Cal., actuator, P/N 452021, 400 ea., actuator, P/N 452024-0-1, 311 ea. manual overide, P/N 551630, 67 ea. (PR SA-611353), $141513.

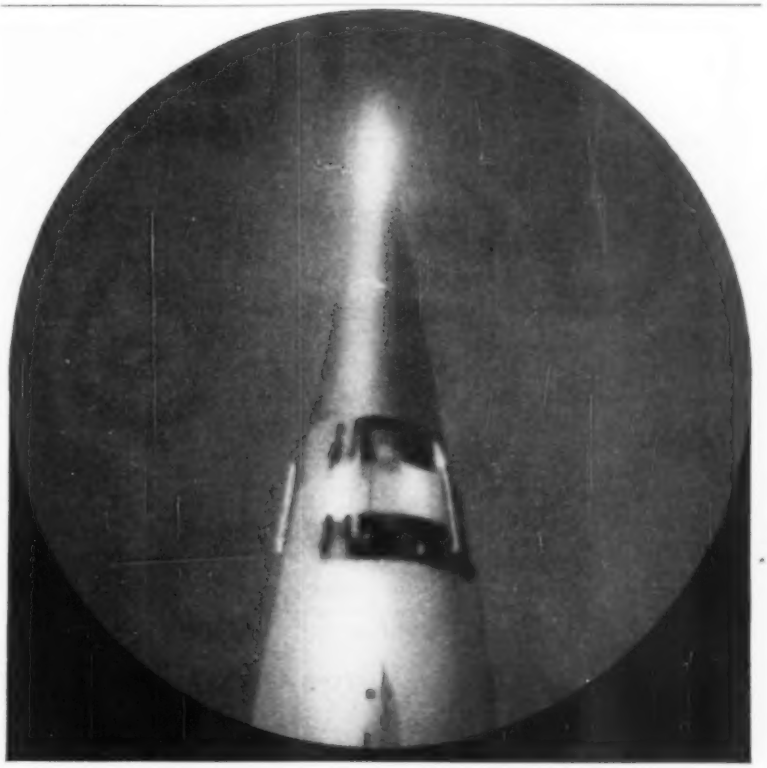
Kollsman Instrument Corp., 80-08 45th Ave., Elmhurst, N. Y., machmeter; pitot static, type A-1 (PR 635995 and OC 705416), 549 ea, $71282.

Hydro-Aire Inc., 3000 Winona Ave., Burbank, Cal., motor, P/N 9427-958357, 3 ea. actuator, P/N 9427-334522, 129 ea. motor, P/N 9427-162510, 248 ea. shaft, P/N 9427-957911-4, 520 ea. (PR SA-611313 "Q"), $82457.

Detroit Controls Corp., Control Engineering Unit, 560 Providence Highway, Norwood, Mass., type MA-1 true airspeed and machnumber amplifiers (PR 635998, 599225, 599226), 1293 ea, $139062.

Riverside Metal Co., Keystone Watch Case & Instrument Div., Riverside, N. J., indicator, position, landing gear, aerno-60-3170 (PR 635974), 18742 ea, $140190.

National Cash Register Co., Main & "K" Sts., Dayton, Ohio, components of ME-5



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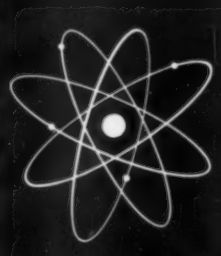

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bombing navigation computers to be used for supply spares, (PR 681215, 709897, 542172 (1)(2), 408090, 408670, 408088), $10341161.

Sperry Gyroscope Co., Sperry-Rand Corp., Great Neck, Long Island, N. Y., control, primary, type MK-1-AF stock no. 6400-219427-95 (PR-408100), 347 ea., $229020.

General Motors Corp., AC Spark Plug Div., Flint, Mich., ME-5 bombing navigational computer components, (PR 408100, WR542172(1) (2), ERN709897, WR-408088, WR 408670, WR 408089), $6161805.

Scintilla Magneto Div., Bendix Aviation Corp., Sidney, N. Y., coil assemblies, P/N 4273-10-33200-1, 432 ea. switch assemblies, P/N 4273-10-51100-1, 39 ea. transformers, P/N 4273-10-58635-1, 44 ea. (PR SA-611359 "Q"), $26934.

American Machine & Metals Inc., U. S. Gauge, Sellersville, Pa., gages, hydraulic pressure, 0-5000 PSI, 758 ea. type AN 5771-T7B, 14076 ea. (PR PE 63945 & PE 635945-1), $120808.

OFFICE OF SCIENTIFIC RESEARCH, Air Research and Development Command, P. O. Box 1395, Baltimore, Md.

Rector & Visitors of the University of Virginia, Charlottesville, Va., research, "Oxidation & Inhibitor Mechanism" (AF18 (603)-103), job, $30000.

Planning Research Corp., 10966 Le Conte Ave., Los Angeles 24, Calif., research, classification of unprepared landing areas (AF18(600)1609), job, $51247.

Bjorksten Research Laboratories, Inc., P. O. Box 265, Madison 1, Wis., research, "Quartz Fibers in High Temperature Resistant Materials" (AF18(603)-42, job, $85112.

Trustees of Princeton University, Princeton, N. J., research, "Applications of the Methods of Modern Topology" (AF(600)-1494), job, $37675.

University of Chicago, 5801 S. Ellis Ave., Chicago, Ill., research, continuation on the algebraic mechanism of fiber spaces (AF18(600)-1383), job, $26508.

Trustees of Columbia University in the City of New York, Columbia University, Box 6, Low Memorial Library, New York 27, N. Y., research, "Dynamic Behavior of Shells" (AF18(600)-1247), job, $27308.

Cornell University, Ithaca, N. Y., continuation of investigation of atomic phenomena occurring on and near the surface of solids (AF18(600)-674), job, $69348.

Navy Contracts

Following is a list of unclassified contracts of $25,000 and over is released by Navy Contracting Offices:

AVIATION SUPPLY OFFICE, 700 Robbins Ave., Philadelphia 11, Pa.

Malabar Mfg. Co., 950 Doolittle Dr., San Leandro, Cal., parts for aviation jacks (383-29065-123S3-24-56), various, $37050.

Aircraft-Marine Products Inc., 2100 Paxton St., Harrisburg, Pa., terminals (IFB-383-887-56), various, $30329.

Erie Mfg. Co., 4000 S. 13th St., Milwaukee 15, Wis., cylinder assys. (383-2150-1336G3-2-52), various, $163674.

Sperry Gyroscope Co., Div. of Sperry Rand Corp., Marcus Avenue & Lakeville Rd., Great Neck, N. Y., spare parts (383-2130-1038E2-3-52), various, $35516.

Holley Carburetor Co., 11955 E. Nine Mile Rd., Van Dyke, Mich., spare parts (383-2117-231-51), various, $25476.

Revere Camera Co., 320 E. 21st St., Chicago 16, Ill., spare parts (383-2140-1896-52), various, $37369.

Leach Corp., Leach Relay Div., 5915 Avalon Blvd., Los Angeles 3, Cal., light dimmer (383-2140-2881-52), 1318 ea, $56318.

General Electric Co., 1405 Locust Street, Philadelphia 2, Pa., parts for various A/C (383-2116-129X3-4-53, 383-2117-176-52), various, $103641.

Weber Aircraft Corp., 2820 Ontario St., Burbank, Cal., pilot seats, (383-2110-1949-52), various, $45920.

Red Bank Div., Bendix Aviation Corp., Eatontown, N. J., potentiometers (383-2140-489-52, 383-2140-477X2-4-52), various, $28-820.

WHAT'S NEW

Publications Received

• *Conflict of Interest*—by Walter F. Pettit—Pub. by, and available from, Small Defense Industries Association, 3780 West Sixth St., Los Angeles 5, Calif. $2.00; 30pp.

This report discusses how ex-government employes and retired military officers can avoid civil and criminal penalties in their work for private industry.

• *Symposium on Impact Testing* — ASTM Special Technical Publication No. 176—Pub. by, and available from, the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. $3.50; 170pp.

The symposium discusses impact and shock tests for parts, components, and complete structures with consideration of the impact tube.

• *Civil Air Regulations and Flight Standards for Pilots*—Prepared by the Associated Aeronautical Staff of Aero Publishers, Inc., 2162 Sunset Blvd., Los Angeles 26, Calif. $2.00; 146pp.

This, the sixteenth edition, includes important civil air regulations, standard flying practices, procedures, and pilot information on obtaining various pilot certificates and ratings, radio telephone use, flying instructions, airport traffic control, questions and answers for private pilot exams, visual flight rules, weather services, and search and rescue information.

• *Professional Consultants' Operations and Techniques*—by Dr. C. C. Crawford—Issued by the Business and Industrial Consultants Committee, Industrial Department, Los Angeles Chamber of Commerce, Los Angeles, Calif. 46pp.

The manual was prepared for consultants, advising them on attracting and finding prospects, selling their services, serving the client, administering operations, advancing the profession, and planning good programs and meetings.

• *Minimum Weight Analysis of Compression Structures*—by George Gerard —Pub. by New York University Press, Washington Square, New York 3, N. Y. $6.00; 194pp.

The author presents discussion of the principles of minimum weight analysis and design of individual compression elements subject to buckling, analysis of the minimum weight configuration of the compression cover and supporting structure under bending loads of various structural arrangements, comparison of various types of construction.

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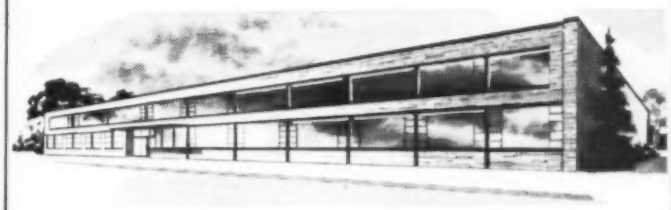

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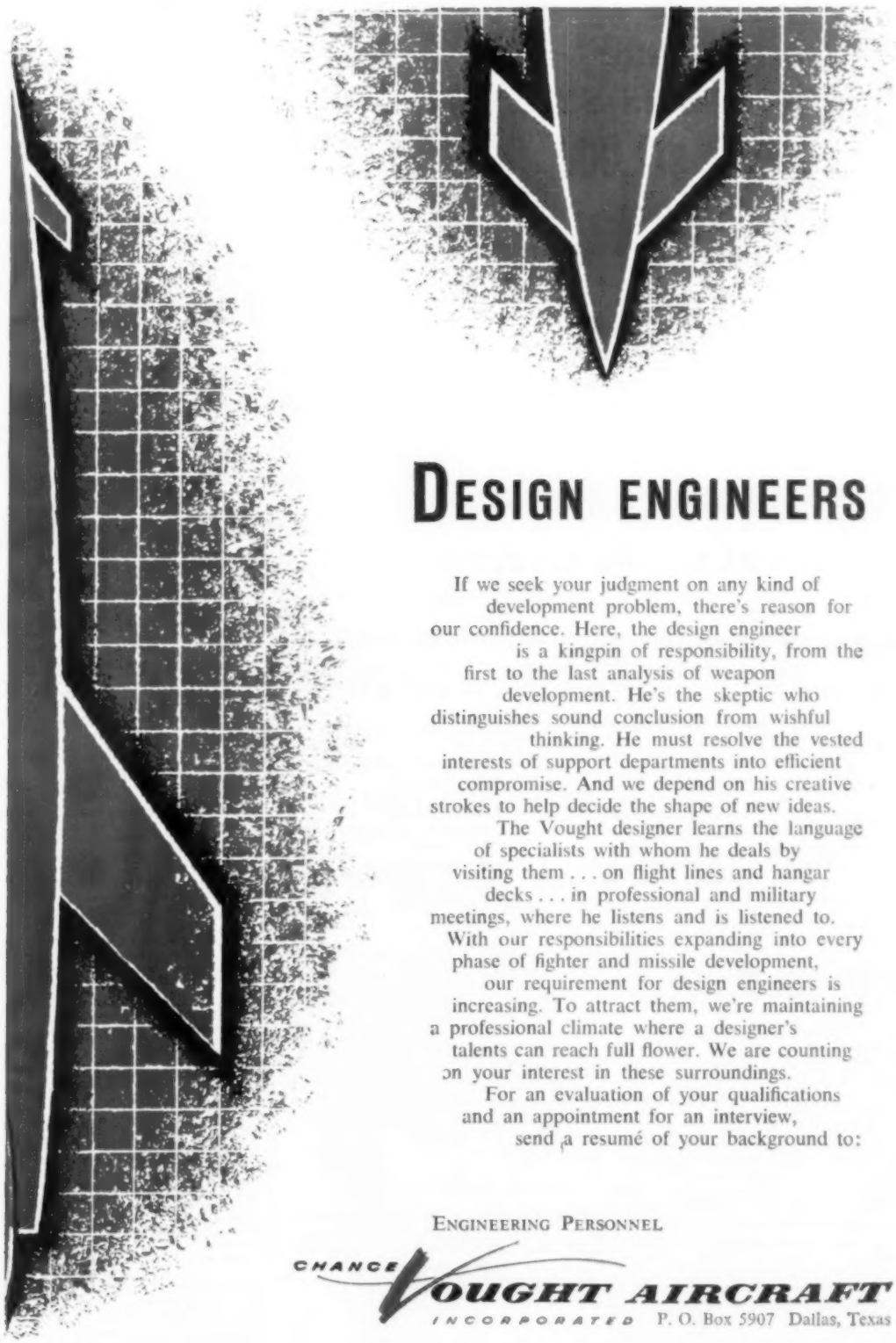

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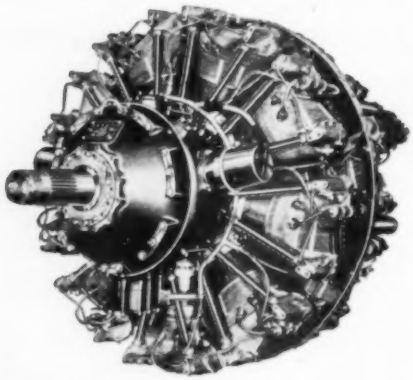

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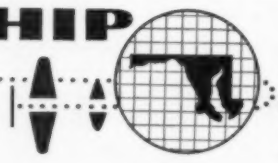

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MEN and the MOON

Last year, on safari in equatorial Africa, John L. Barnes bagged two elephants, a waterbuck and a buffalo. But he was after bigger game than that. One purpose of his expedition was to investigate possible launching sites for a missile to the moon.

Fantastic? Not at Systems Laboratories Corporation, the first scientific organization in the world dedicated to the research and development of interplanetary space travel. As SLC's president, Dr. Barnes – himself one of the world's foremost authorities on the guidance and control of long-range missiles – heads a group of some of the top scientists and engineers in the country. Among other challenging projects in the fields of aero- and spacenautics, these men are already actively engaged in planning man's first exploration of outer space.

If you would like to know more about Systems Laboratories, and the distinguished men of science, mathematics and engineering who comprise its staff, a note to the address below will bring you further information.

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LETTERS

Engineering Defense

Many letters have recently been published tending to downgrade the engineering profession. I wish to say a few words to the contrary, for certainly engineering is vital to our well-being, our betterment, and, indeed, our very existence.

There are several factors that should be considered when one decides on a profession: (1) professional growth, (2) professional recognition, (3) financial remuneration, and (4) personal satisfaction. The preferential order of these factors depends, of course, on the individual concerned.

The engineering profession offers all four in better than adequate measure. Opportunities for professional recognition and for professional growth are afforded every engineer in practically every company. Interesting and diversified projects, publication of technical reports and presentation of papers are encouraged in any number of technical societies. Excellent technical consultation and well-stocked libraries are available. College courses leading to advanced degrees, financed wholly or in part by industry are a stimulating and rewarding opportunity. Patent and suggestion award plans are almost universally endorsed. In our expanding industries, the engineer has assumed ever increasing responsibilities. Indeed, engineering personnel at top management level is in a decided upswing.

Financial remuneration in the engineering profession was recently published by the U. S. government as being second only to medicine as the top average income field. Surely everyone considers himself underpaid and is desirous of greater financial reward; however, the fact remains that a median salary of $10,000 is certainly a reasonable remuneration.

Personal satisfaction encompasses a number of variables such as location, home life, interest in work being performed, and the feeling of actually contributing something to the betterment of one's company and mankind. It was once stated that engineers are the least neurotic of all professional groups, which certainly indicates a high degree of personal satisfaction. Look around you—ask—the results might surprise you!

In conclusion, I wish to state that I am not only happy with my chosen field, but I am proud to be an engineer. Let the public go its leisurely way, utilizing the comforts and conveniences given them by engineering. Designing, building, and giving the public these items, and thinking in terms of tomorrow is far more stimulating.

W. H. Wheeler
Engineering Laboratory
Glenn L. Martin Co.
Baltimore 3, Md.

Parachute Meet

It is noted in the picture caption on p. 71 (AW. Sept. 3) that the Soviet Team won the parachute meet. This is an error as the Czechoslovakian Team won first place and the Soviets got second place. On the fourth event the Soviet Team was beaten by the Czechs for so many points that the Czechs won the overall meet.

The U. S. Team came sixth in the meet but I think they did well considering the amount of experience and training they had compared to some of the other teams. I do not think the Russians should be given credit for something they did not win.

Joe Crain
Director, U. S. Parachuting Team
Mineola, N. Y.

(*Apologies. Aviation Week was misinformed.—Ed.*)

Aviation Week welcomes the opinion of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Copilot vs. Engineer

Your July 30 issue carried a letter by a "United Flight Officer" (p. 102) which was of interest to me, inasmuch as he inadvertently hit upon a basic issue in the cockpit of the large airliner of today: should the flight engineer be a pilot or a mechanic? Then he went further and, in his own words, showed why he should basically be a mechanic, and concentrate on becoming a professional flight engineer, rather than simply an inexperienced third crew member watching an ADF needle swing and completely ignoring a wiggling BMEP gauge.

This "United Flight Officer" showed how, with only 200 hours of G. I. Bill training and 17 weeks of "intensive" training with United, he received an instrument rating, qualified as copilot, and "won" a Flight Engineer's Ticket. (The use of the word "won" here is very significant.) Then, he has us believe, he was completely qualified to operate, trouble-shoot and, if necessary, repair any one of the hundred-odd components of a dozen or so systems of a 53½ ton airplane!

It should be obvious to anyone who knows the complex airliner of today that one person can not perform both the duties of a copilot and those of the flight engineer, and do so with any degree of efficiency. Mr. "United Flight Officer" was apparently trying to do both simultaneously as he was learning the duties of a copilot while supposedly performing the duties of the flight engineer. The only reason he was able to get away with this is that he was obviously flying a type of aircraft in which the pilots both have access to the engineering controls and instruments, and could monitor these items from time to time. However, such a condition greatly increases the workload on the pilots. In my opinion, it is an unsafe condition in which a pilot must be concerned with engine instruments and controls when he should be either looking out for other aircraft or concentrating on a complex let-down followed by a marginal ILS. If he had no confidence in his inexperienced flight engineer, it follows that such a situation might arise.

It is fortunate that the largest, most experienced, safest and most prosperous airlines of our country (and abroad) realize the advantage of having licensed mechanics as their flight engineers. Following their example, it is logical to separate the duties of the pilots and the flight engineers.

J. F. Femmenino
Flight Engineer
Jamaica, N. Y.

Cartridge History

As a person familiar with their use in the emergency escape systems of USAF aircraft, I enjoyed reading George Christian's article on cartridge-actuated devices (CAD) in the July 30 issue of Aviation Week (p. 63).

However, I would like to point out that from a historical sense alone, I think the Air Force program with Ordnance Corps and the pioneering work of a few dedicated people at the Wright Air Development Center and Frankfort Arsenal deserved more than the one sentence mention in the article.

Commencing in the summer of 1945, the WADC and Frankfort Arsenal worked together on the design and development of the first ejection seat catapult for the Air Force. This catapult was ultimately standardized in 1947 and designated the M1 Personnel Catapult. The design and development of the M1 and M2 canopy removers followed in quick succession. These early CAD's were mechanically actuated, i.e. cocked firing pin released by rotating or withdrawing a sear. The "choke coil," bell crank-rod, etc., actuating systems for these CAD's left much to be desired from a reliability, simplicity, and maintenance standpoint.

In 1949, Frankfort Arsenal developed a propellant gas pressure source which was designated an initiator. Concurrently, the Arsenal redesigned the existing CAD's to incorporate a pressure actuated firing mechanism. The propellant gas pressure was transmitted by MS-28741 hydraulic hose assemblies from the initiators to the CAD's to be actuated.

With the advent of the B-52 and its requirements for a multi-crew, multi-functional integrated escape system, it was realized that a new form of CAD might ideally furnish the thrust to position ejection seats, unlock hatches, stow control columns, etc. With the enthusiastic support of the airframe contractors, the WADC and Frankfort Arsenal commenced the design and development of the first series of thrusters, designated the M1, M2, M3, and M5, in 1951.

Since that time, many new and varied applications for CAD's have been found in the escape systems of USAF aircraft. Today a total of 20 CAD types have been standardized by the Air Force and many more experimental types are rapidly approaching a standardized status.

Charles K. Hodell
Aircraft Laboratory
Wright Air Development Center

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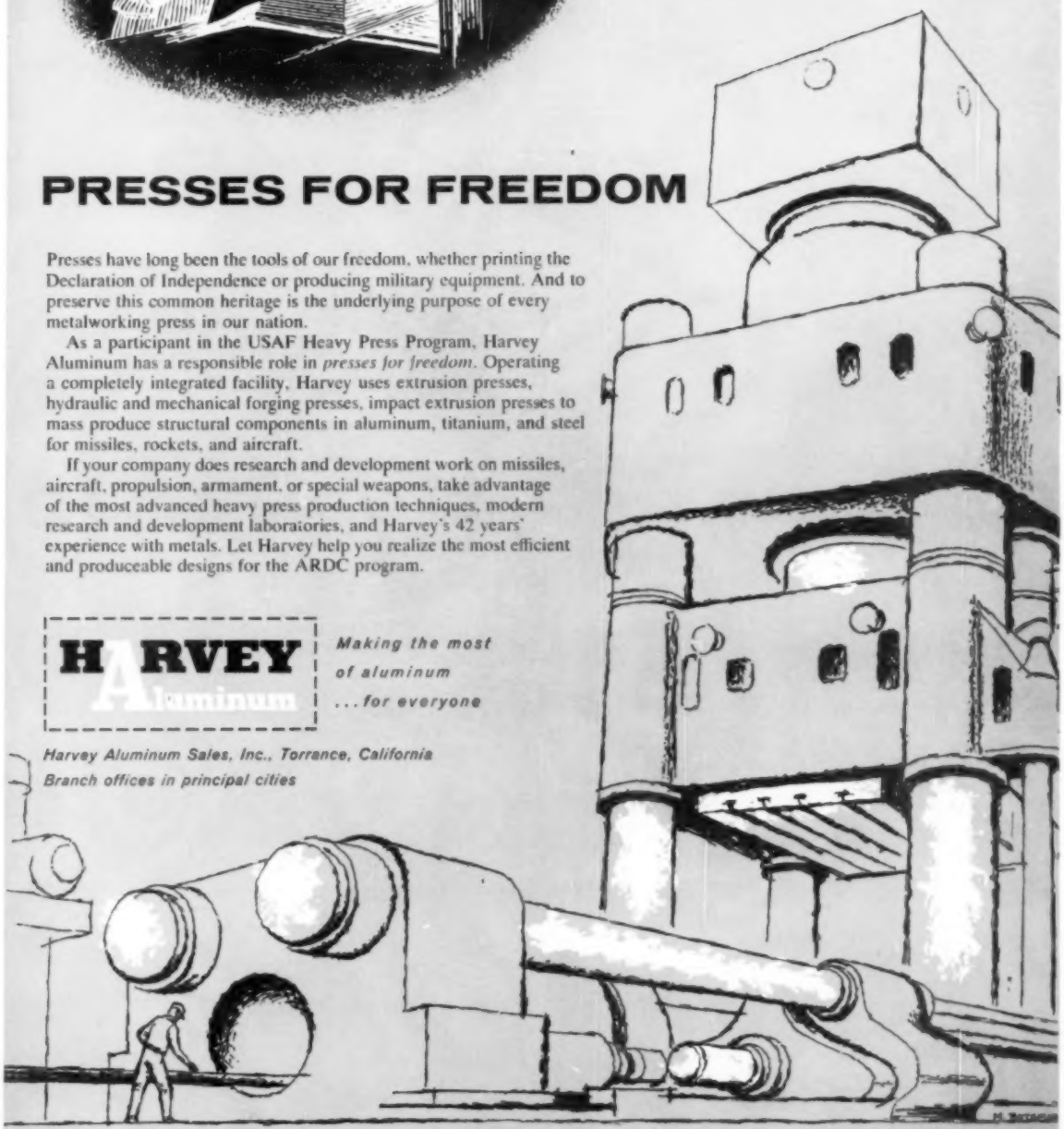

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